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[656 (.436)]

Co-ordination of rail and road transport in Austria,

by F. STRAUSS, Vienna.

The growing difficulty of their financial position has for some years forced most railways not only to reduce their expenses to the lowest possible level but also to find means for increasing their receipts. Now that a general increase in the rates is hardly possible, great energy is devoted to fighting road competition. The solution of this serious problem far exceeds, in importance, the ordinary course of events and imposes on each State quite new responsibilities as regards the financial and social policy to be followed, the political economy to be adopted, and at the same time as regards its budgetary and national strength.

Austrian regulations on road motor lorries.

An order of the Federal Government, which came into force on the 1 July 1933, provisionally for the period of one year, is intended to organise, first of all in the case of the goods services, co-ordination between the railway and the road motor, as the latter's competition, entirely uncontrolled up to that date, was very seriously compromising the existence of these two indispensable methods of transport from the public point of view.

Te aim of this order is to assign, in principle, to each of the two methods of transport the traffic which it can best handle, i. e. it assigns long-distance transport to the railway, and short-distance traffic to the motor lorry.

Introduction of minimum rates.

The order provides that goods can only be conveyed by motor lorry beyond municipal boundaries against payment of minimum rates.

In order to arrive at these rates, the following kilometric rates per 100 kgr. are usually taken as the basis :

	Up to 50 km. (31 miles)	Above 50 km. (31 miles and up to 100 km. (62 miles)	Above 100 km. (62 miles)
Full loads. .	0.03 S.	0.03 S.	0.035 S.
Other consignments (including parcels).	0.065 S.	0.05 S.	0.04 S.

The rates for full truck loads are applicable to merchandise of the same kind despatched by a consignor to a consignee by motor lorry, if need be with a trailer, and this for distances of less than 100 km.

(62 miles) on payment of the rate corresponding to a minimum weight of 10 000 kgr. (9.84 Engl. tons).

For smaller consignments of merchandise sent by a consignor to a consignee by motor lorry, if need be with a trailer, to maximum distances of 100 km. (62 miles), the kilometric rates amount, against payment of the tax corresponding to a minimum weight of 5 000 kgr. (4.92 Engl. tons), to 0.05 S. for distances not exceeding 50 km. (31 miles) and to 0.04 S. for distances exceeding 50 km.

For distances of 50 km. or less the carriage charges are calculated according to the total real distance and the corresponding kilometric rate. For distances exceeding 50 km. up to 100 km., the charges are arrived at by adding, to the part rate for 50 km., the part rate representing the product of the kilometric rate for the distances exceeding 50 to 100 km. by the part of the total distance which exceeds 50 km.; for distances over 100 km., the rates are obtained by adding to the part rate for 50 km., and for more than 50 km. up to 100 km., the part rate representing the product of the kilometric rate for the distances exceeding 100 km. by the part of the total distance exceeding 100 km.

In the case of traffic in competition with private railways which, owing to their smaller track mileage and their higher working costs, require greater protection, a suitable increase in the minimum rate reduces to some extent the limit of the economical use of the motor lorry.

Moreover, for traffic not worked or not worked economically by railway companies, the Ministry of Commerce and Transport can, on receipt of a properly substantiated demand, authorise, either as a general measure or for certain commodities, an alteration in the minimum rates in force if circumstances really worthy of consideration absolutely require it.

The distances to be brought into account to meet the above mentioned arrangements should be calculated from the place of origin to the point of delivery by the shortest road route available for general motor lorry services.

The minimum rates apply to the motor lorry services, not only on the lines in competition with the railway, but in a general way; the reason is that these minimum rates represent nothing more than the operating costs increased by a reasonable profit.

Introduction of new waybills.

In accordance with the terms of the order, any firm transporting goods by road motor against payment beyond the boundaries of a municipality is obliged to keep *returns* of the transport carried out, giving the date when the contract was gone into and that when the transport was carried out, the name and trade of the consignor and of the consignee, the place of despatch and that of arrival of the goods, the kind of packing, the nature of the goods and the weight of the consignment, the kilometric length of the line worked over and the amount of the rate charged; in addition, the firm is required to complete, for each consignment forwarded, *waybills* which accompany the goods, each of these waybills relating to not more than the load of one motor lorry with its trailer. These returns and waybills can however be replaced by *carriage journals* numbered consecutively, which the driver of the motor lorry or his assistant has to carry with him and in which these men have to insert at once particulars of all goods loaded en route. The motor lorries em-

ployed on goods transport against payment, outside the territory of a municipality, have to be clearly marked with the name and address of the carrier and the capacity of the vehicle (and that of the trailer if used), in tons. The returns and waybills, or the carriage journals as the case many be, have to be kept for three years from the date of the transport or of the last insertion.

Regulations concerning private industrial services.

In the case of private industrial services, the order only authorises the transport of goods by motor lorries belonging to the works or in continuous use on the account and risk of the owner or his staff, provided that it is a question of transporting the products of the business or of materials required by it (raw materials, semi-manufactured materials, packing materials, tools, supplies, manufacturing equipment, etc.) or of commercial products for the firm itself, or of products on which the firm carries out further operations (improvements, repairs, etc.).

Private industrial transport is only allowed for distances not exceeding 100 km. (62 miles) except in the case of such things as beer, ice, milk, bread, livestock, mineral oil, linen, chemical and sugar products conveyed in special vehicles. Such commodities may be carried, in private industrial service, in special motor lorries exclusively reserved for the conveyance of these products, without other material being carried at the same time, over distances exceeding 100 km. These lorries have to be given the special mark WK (> 100), whereas the other lorries in industrial service are marked WK. The distance of 100 km. is calculated from the local boundary of the locality in which the lorry is permanently stationed to that of the final place of destination by the shortest route on which motor lorries are generally allowed.

Control of the motor lorries.

In order to ensure the measures adopted being successful, the Order makes provision for the public authorities, as well as the Federal Ministry of Commerce and Transport and the staff delegated for the purpose by this Ministry to have the right to demand at any moment from the carriers, the drivers of the lorries and the consignors, information regarding the goods conveyed beyond the boundaries of a town and on the charges paid as well as the production of the statements, waybills, and carriage journals which the firms engaged in transport have to keep, including transport carried out by private industrial services, and to ascertain that they agree with the actual facts.

It is also laid down that railways working a public service are authorised to abolish, before the expiration of the periods of availability, as published, rates reductions which they can prove were put into force to meet road competition; in this case the minimum tonnage laid down should be reduced in proportion to the reduction of the period of availability.

Any infringement of this order, whether intentional or through negligence, will be severely punished : if the offence is repeated, the competent authorities can even withdraw the license for transport of goods by motor lorry.

Amalgamation of the road motor services of the Austrian Federal Railways.

In order to assist the Austrian Federal Railways in carrying out the duty imposed upon them of dealing with public traffic in the general interest, a limited

liability company, the « KÖB », was formed on the 1 August 1933 to take over the road motor services of the Austrian Federal Railways by amalgamating into one independent company the road motor services operated by the railways, previously known under various names such as : Federal Road Motor Service, Lobeg Ltd., Nibug Ltd., Sol Ltd., with the exception of the cartage services of the Austrian Federal Railways in Vienna.

The « KÖB » has its shareholders, board of directors, and managing director.

The responsible executive officer is the managing director. He is responsible for the safety, regularity, and economy of working, and also for safeguarding the interests of the Austrian Federal Railways in setting up, or abandoning or working road motor services, and in accepting or refusing the transport of passengers and goods.

The managing director is assisted in these duties by departmental managers. Each department is a separate entity, and is managed, in accordance with the instructions issued by the managing director, by a divisional manager. The business is divided into the three following departments : Administrative, Operating, and Goods.

The local operating service is carried out under the orders of the managing director by district officers. The latter are responsible for the whole of the working and especially for safety, order, regularity, and economy, within the limits of their districts. They are also expected to endeavour to increase the traffic in their district and to send in, at regular intervals, reports on this subject, as well as on the conditions under which competition takes place and, if need be, on any required extension of the road motor services.

Close contact between the Austrian Federal Railways and the « KÖB » is guaranteed by the following provisions of the order :

Without prejudice to the liberty of action legally conferred upon it, the « KÖB » shall carry out its activities in such a way that the interests of the Austrian Federal Railways shall be safeguarded at all times from the double aspect of service rendered and profits. As the sole sharebolder in the « KÖB », the Austrian Federal Railways issue the regulations required to permanently safeguard the common interest.

In order to make use of the stock of materials held in store by the Austrian Federal Railways, and to benefit by the better conditions under which they are purchased, the « KÖB » will obtain all constructional materials and working and consumable stores, from the Stores Department of the said Railways.

The « KÖB » carries out its activities in direct liaison with the corresponding services of the Federal Railways. This liaison service is placed under the authority of the office specially responsible for dealing with questions of competition. If this office and the « KÖB » disagree on any point, the management of the Federal Railways decides the matter. The staffs of the two undertakings are expected to render one another mutual assistance and to work in full agreement in all matters concerning the common interest. The order makes provision for work to be carried out by the railway staff on behalf of the « KÖB ».

Against this, all work done by the Federal Railways for the « KÖB » should be debited by the former and accepted by the latter at its full cost. In the same way, as regards charging interest for stores and loans, the « KÖB » has to be treated as a third party independent of the Railway. In addition, work done by

the « KÖB » at the request of and in the sole interest of the Federal Railways, which according to the accounts involved the « KÖB » in a financial loss, are debited to the Federal Railways under a separate account, for not more than the book figures.

The working conditions of the staff employed by the « KÖB » are governed by the general regulations applicable to employees and workmen in private industry. The regulations on the salaries and rights of the Federal Railways staff are not applicable in principle.

Special Office for dealing with questions of competition set up at the Austrian Federal Railways.

When the « KÖB » was constituted, a special office to deal with questions relating to competition was formed at the same time, to deal with the following matters :

Consideration of general questions, matters of principle and special subjects connected with competition; elaboration of schemes, proposals and other work relating to the most suitable methods of abolishing or reducing competition with other methods of transport; agreements to be entered into with the « KÖB » on questions of rates, timetables, and substitution of trains; contracts with the Post Office on all matters of collaboration between the Federal Railways, the « KÖB » and the Post Office motor services; matters relating to the acquisition of new concessions or the cancellation of existing contracts and the completion of all negotiations in connection therewith in agreement with the « KÖB »; position to be taken up in face of demands for concessions made by third parties.

Co-ordination of the services of the Federal Railways, the road motor services of the Federal Railways, and the Post Office road motor services.

An agreement between the General Management of the Austrian Federal Railways and that of the Post and Telegraph Department was entered into, in 1933, with the object of ensuring closer and more economical co-ordination of the railway services, of the railway-worked road motor services, and of the Post Office road motor services, in the interests of the country, of the public and of the two administrations themselves, and also for mutual assistance and defence against competitors.

This agreement in particular provides for the following :

Before new motor services are opened or lines, the working of which had been suspended, are again operated, the two parties shall come to an agreement upon the subject and, if need be, organise the working of the line so as to ensure the greatest possible economy. When the opening of new lines or reopening of existing lines is under question, the agreement will in general be based on the principle that, as regards the right to operate, priority shall be given to the Post Office for the feeder lines, and to the Railways or their road motor service, as the case way be, for parallel or by-pass routes.

When drawing up road motor service timetables, the railway timetables or, according to the case, those of a road motor service of the other contracting party, are to be taken into account, a distinction being made between the parallel lines and those running in connection with the main lines. In the case of parallel lines,

timings coinciding with those of the trains are to be systematically avoided, as on such lines the road motor service is intended not to be a competitor but a complement to the existing rail traffic. The services must be so arranged that, while safeguarding the economic character of the train service, the needs of the traffic offering at the different times of the day may be met. In the case of branch lines, care must be taken when getting out the timetables to see that connections are made between the two services, the road motor timings having to be subordinated, in principle, to the train times.

Fixing of ticket rates, and alterations thereto, issuing of return tickets, granting of reduced fares, etc. for the Post Office and Federal Railway motor services shall be done in agreement, the rates on parallel railway lines or on parallel railway or Post Office motor services being taken into account if need be. Combined rail and road tickets shall be issued when this is deemed economical.

The two contracting parties agree to allow to the fullest possible extent the common use of garage accommodation by their respective vehicles and to give mutual assistance in operating the vehicles and repairing them. In addition, the two parties undertake, in case of necessity, to lend each other road motor vehicles and drivers not required for working their own traffic. In the same way, motor vehicles will also be lent to the Federal Railways in case of disturbance of the traffic by rail.

Finally the agreement makes provision for investigating the economic necessity for parallel lines, the requirements of public traffic being duly considered.

The regulation of the relations between rail and road is of capital importance in the Austrian traffic problem. At the moment no definite judgment can be formulated on the whole of the financial results obtained through the reorganisation of the transport industry in Austria. As the economic working of the Austrian Federal Railways has become one of the most serious items in the Austrian State Budget, the introduction of economic road motor services is now a national and industrial problem.

[621 .335]

Present state and future development of the use of accumulator-driven rail motor cars,

by K. Wilh. LANDMANN, Diplomingenieur, Berlin.

(*Verkehrstechnische Woche.*)

The German State Railway Company, and both the Prusso-Hessian State Railways and the Bavarian Palatinate Railways built, between 1898 and 1928, a total of 208 rail motor cars driven by accumulators. As stipulated in the Peace Treaty, 18 of these cars were handed over to Poland (all these are still in service) and 7 to France (Alsace-Lorraine). In addition, 4 are running on the Sarre Railways. Of the remainder, two of the oldest vehicles built in 1898 have been withdrawn from service on account of old age, two have been sold to a minor railway, and a few have been withdrawn from service as the result of collisions or other accidents. 168, mostly large units consisting of two or three bodies seating over 100 passengers and with which it has been possible during the whole of this time to give a working noted for its regularity and cheapness, remain the property of the State Railways.

In 1932, the whole of the accumulator-driven rail cars of the German State Railway Company ran 10.5 million motor-coach-km. (6 525 000 motor - coach-miles) and 3 million trailer-km. (1 864 000 trailer-miles). The total length of the lines which they served in 1932, was 7 500 km. (4 660 miles), that is about 14 % of the whole German State Railway System. The average distance run by the cars has been about 62 000 km. (38 530 miles), and the maximum of a car with a 300-km. (186 miles) battery, about 90 000 km. (55 925 miles). The 168 German rail cars in question are distributed between 47 stations and their maintenance is dealt with at 8 repair shops. The power consumption for charging their batteries is about 20 million kw.-h. per annum.

No new rail motor cars have been built since 1928, but the two and three-car units have had their batteries systematically replaced by more powerful ones, which was made possible by the constant improvement of the accumulators.

In making these replacements, the results obtained during dozens of years' service have been taken into account. The double units of an older type, originally fitted with batteries capable of covering a distance of 100, 130 and 180 km. (62, 81 and 112 miles) were gradually fitted with batteries with which they could cover 300 km. (186 miles) on the level per charge. In the same way, the cars of a more recent type, originally fitted with batteries of 200-km. (124 miles) capacity, were gradually fitted with others which gave them a radius of action of 250 km. (155 miles). As the result of this work, the German State Railway Company found itself, after some years, able to double, and more than double, the distance run by the accumulator-driven rail cars without increasing the stock of such vehicles.

Whereas in Germany new vehicles have not been built during recent years,

because it was considered sufficient to get a greater mileage out of the vehicles in service by using more powerful batteries, the railway companies in other European countries have — recently — built accumulator-driven rail motor cars according to a speeded-up schedule or extended existing rail motor car service, or they propose to use accumulator-driven rail motor cars on a larger scale.

Railway operation by means of accumulator-driven motor cars has, moreover, been discussed at all the great international meetings of railway engineers.

Thus, Mr. Lo Balbo, Manager of the Piedmont tramways, at Saluzzo in Italy, who has used accumulator-driven rail motor cars for some years for the whole of the passenger service on the lines he controls, gave a paper at the Warsaw Congress of the International Tramway Union (1930), on the extremely favourable results obtained with this type of vehicle.

During the Madrid Session of the International Railway Congress Association, held the same year, accumulator-driven rail motor cars were very fully dealt with.

Mr. Lo Balbo also gave a long lecture at the International Electricity Congress in Paris (1932 Summer), in which he dealt with the question of accumulator-driven rail motor cars and their advantages.

In a paper read in February 1932 at Brussels before the Belgian Electric Power Stations Association, Mr. Ryffranck, Engineer of the Flanders & Brabant Power Stations, dealt at length with accumulator-driven rail motor cars.

In July 1931, the President of the French Association « L'Industrie des Voies Ferrées et des Transports automobiles », Mr. L. Jeancard, read a remark-

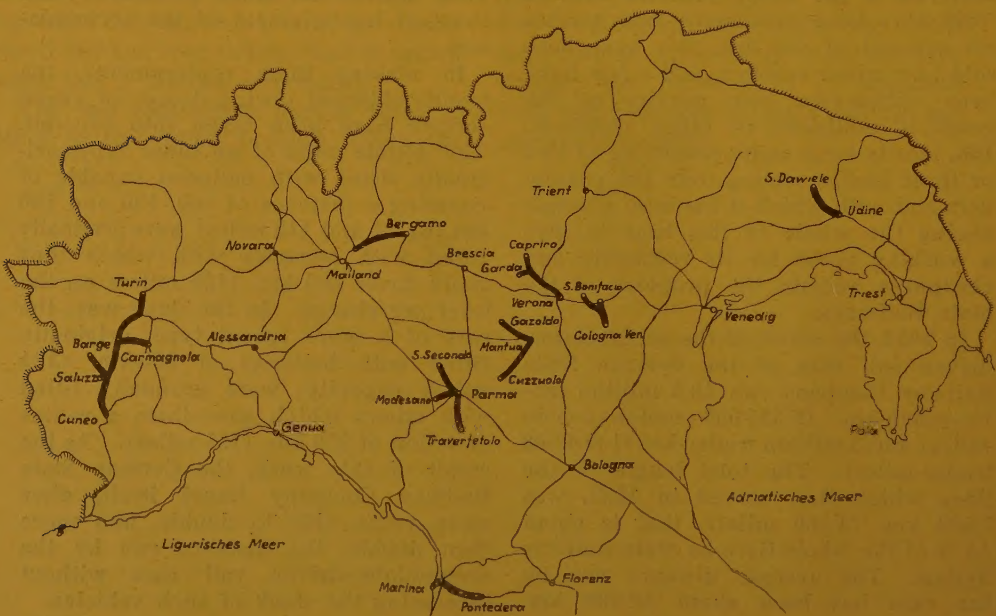

Fig. 1. — Railway and tramway lines worked by accumulator-driven rail motor cars in Northern Italy.

able report at the General Technical Meeting of this Association (reproduced in the February 1932 monthly Bulletin of the said association), on the very favourable results obtained with a large number of accumulator rail cars on the French light railways he managed in the Charentes. He spoke at length on the good results obtained from a regenerative arrangement fitted.

In addition to the above mentioned railways and a few of the French lines, some of the local lines in Upper Italy have put some 30 accumulator-driven rail motor cars into service, with the greatest success from an economic aspect. Their batteries, like those of the German State Railway Company, are maintained under contract by the accumulator makers, so that these railways can be worked on fixed maintenance figures as regards the batteries. Figure 1 shows the extension of the services worked by such battery-driven cars in Northern Italy.

The Yugoslav State Railways have included a number of accumulator-driven cars in their recent orders for rail motor cars. In the same way, the Rumanian State Railways are taking a great interest in this method of working.

The Czechoslovakian State Railways have ordered from the Skoda Works a goods rail motor van which is to be driven by accumulators and by an internal combustion motor as well. The Skoda Company have taken out a patent on the system chosen, which consists in running the battery and the dynamo of the generating set in series on up gradients, so as to obtain higher speed by increasing the voltage.

Special mention should be made of the introduction of accumulator-driven rail motor car services in Ireland. The Government has followed the construction of these vehicles with great interest and has assisted it financially to a large extent. Two large double-unit cars, like those of the German State Railway Company, have been put into service experimentally and appear to have given exceptionally favourable results. The Irish Free State is very much interested in the introduction of rail motor cars of this kind, as they would use current produced within the country. It is hoped that considerable economic advantages will be obtained in this way.

To sum up, we see that, particularly in recent times, the use of accumulator-driven cars is being given close attention in most European countries, and is progressively expanding everywhere. The introduction of this method of traction is much favoured in Northern Italy by the higher authorities, who are fully aware of its advantages, either by providing funds for building new stock and batteries (Ireland), or by subsidies, by postponing the date at which the State will purchase the lines, or by concessions (Italy).

The predecessor of the Reichsbahn, the Prusso-Hessian System, was the first railway in the world to operate accumulator-driven rail motor coaches on a large scale. It was also, from this fact, the first to recognise that steam train services should be completed by rail motor cars, and to draw conclusions from this now admitted fact.

« This railway has obtained the very best results during the many years these vehicles have been used. In addition to the greatest reliability in service, due especially to the simplicity of the design, hence of the driving, battery-driven rail cars are noiseless when running, work without emitting any offensive smell, and are free from vibration. Owing to the heavy overload electric motors can stand, the cars can adapt themselves to momentary traffic fluctuations within wide limits, without the efficiency falling off to any extent. The cost of repairs to these vehicles is moderate, and the expenditure on current maintenance is relatively low. As regards working costs, these are rather low, provided

current can be obtained at a reasonable rate. » (1).

When the chances of the use of accumulator-driven rail motor cars growing are being considered, the error of comparing such cars now in service on the German State Railways with modern internal combustion motor driven cars should not be committed. As the newest of the battery-driven cars were ordered seven years ago (and the others before the War), it will be understood that, in view of the extraordinary rapid rate of evolution of rail motor cars in recent years, their running qualities are not such as will meet any condition. It must be remembered that they were built to meet the less exacting needs of the period. Much greater importance is now attached to the interior arrangement of these rail motor cars. Consequently it is not suprising that the public, accustomed to the improved internal combustion rail motor cars and other passenger vehicles, expect the accumulator-driven cars to be to the same standard.

Briefly, none of the battery-driven rail motor cars of the German State Railway Company has benefited from the recent improvements in modern rail motor car construction, so that this railway does not own a single accumulator-driven rail car built according to the latest practice, neither as regards riding qualities nor construction and interior arrangement. For this reason, any comparison of the accumulator-driven cars at present in service with the recent types of internal combustion engined rail cars can quite easily be misleading.

Often those who, while admitting the undisputable advantages of accumulator-driven rail motor cars, in their judgment take into account the above mentioned circumstance, defend the argument — especially at the present date when the best way of increasing the traffic is thought to be by raising the speed considerably — that the battery-driven car is hardly suitable for meeting the requirements of modern rail motor car services, for three reasons. The first argument is that it is proportionally too heavy, which, it is said, brings with it several disadvantages : uneconomical operation, little margin for acceleration, small possibilities on hilly lines. The second reason given is that the restricted radius of action is a very inconvenient feature. Finally, it is brought out that the dependence upon a charging station is a serious hindrance to the use of accumulator-driven rail cars.

That the weight of a rail motor car really has the importance generally attributed to it may, however, be questioned. If one is of the opinion that the present tendencies are irreconcilable with the inevitably high weight carried on the rail motor cars, and if consequently it is considered desirable to abandon the use of accumulator-driven rail cars as being uneconomical, it is necessary, nonetheless, to consider that it is not the advantages resulting from the saving of energy which govern the usefulness of a vehicle, but the safety of the service, and the *total operating costs* including the cost of maintenance and renewal. The power consumption which undoubtedly depends to an appreciable extent on the weight of the vehicle, only represents part of the total operating costs. It is perfectly possible — and many examples confirm this in practice — that a very economical vehicle from the point of view of power consumption is much less so from the point of view of the total working cost, owing to frequent and costly maintenance work, the holding in store of large stocks of spare parts, the necessity for special workshops for repairing the vehicle or its principal parts, the necessity

(1) Regierungsbaumeister Pfarr : *Entwicklung und Aussichten des Speichertriebwagenverkehrs in Europa* (Extended use and future developments of accumulator-driven rail motor coaches in Europe). Helios, 1931, fasc. No. 46.

for using particularly well trained staff, the need for providing standby vehicles, the poor utilisation of the driving staff due to the vehicles being frequently laid up, disturbances in the train working, etc..., than a vehicle which, whilst giving less favourable results from the point of view of power consumption, is perfectly reliable in service, requires few repairs, and practically never requires a standby coach. Thus, to select a typical example, theoretically a vehicle may be conceived weighing 100 tons, of a given power, which is more advantageous as concerns the total working cost than another vehicle of equal power, weighing 10 tons, although undoubtedly the latter will use much less energy.

As regards the general economy of accumulator-driven rail motor cars, it appears indisputable, as a result of the long years of experience on the German State Railway Company with the two types of rail motor cars, that the battery-driven rail motor cars, in spite of their higher weight, are always able to hold their own in this respect against the rail motor vehicles with internal combustion engines, and that they are even better than the latter, thanks to their very low maintenance costs — 8 to 10 % — and their recognised superiority from the point of view of greater reliability in operation; in addition, they have the great advantage of being able to use power produced with the materials and resources of the country, while it is necessary to import the greater part of the fuel used for Diesel engines. Finally the price of electric power has a very great tendency to drop, whereas it is probable that, as the number of Diesel motors increases, the price of fuel oil will gradually rise until it reaches that paid today for petrol.

We would point out to the partisans of the theory that the higher weight of battery-driven rail motor coaches does not make it possible for them to reach with a sufficient radius of action, the speeds considered necessary today, that this theory can no longer stand, seeing that today with battery-driven rail motor cars, it is possible to reach without difficulty speeds of 75 km. (46.6 miles) an hour and over, as well as accelerations of as much as 0.60 m. (2 feet per second per second), the radius of action remaining sufficiently great.

It is true that accumulator-driven rail motor cars are less suitable for high speeds imposed today on rail motor vehicles intended to supplement express trains on main lines. On the other hand, there is no doubt that they are particularly useful and economical for all small railway companies, and on all the secondary lines of the German State Railway Company, which represent 43 % of its system. Modern types of battery-driven rail motor cars can, moreover, be used most successfully on the main lines of the State Railways, especially for services between neighbouring large towns.

The question as to whether rail omnibuses, in which great interest is taken at the present time, and which appear very suitable for running trains at close intervals on small railways and secondary lines, can be built in the form of accumulator-driven vehicles, has already been considered. It has been proved that this is quite possible, and that here again a large field is open to the accumulator-driven rail motor car. Figure 2 is a projected design for such a vehicle, prepared by the « Wismar Waggonfabrik ».

If in many cases it is possible to consider the introduction of rail motor coaches on long journeys for replacing trains giving bad financial returns, which follow one another at long intervals, the rail motor cars are in the main used only on short sections of line, for example to replace short and too expensive steam trains, with tightening up of the time table, for suburban traffic of small towns and cities of average

size, for correspondence services between the stopping stations of the expresses, and especially for separating the passenger traffic from the goods traffic on the light railways and secondary lines.

The principal field of use is that of the light railway upon which high speeds are less important and which moreover are not possible in most cases, as the allowed speeds do not exceed 30 km. (18.6 miles) an hour, and can only be

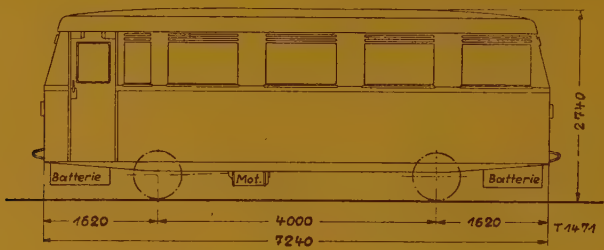

Fig. 2. — Accumulator-driven rail motor coaches.

Design of the Wismar Waggonfabrik for 40 passengers (28 seated and 12 standing), and a maximum speed of 50 km. (31 miles) an hour, with easily replaced AFA battery. Total weight, including passengers, 11 tons. Radius of action with one charge of the battery : 200 km. (124 miles) on the level.

raised to 60 (37.3 miles) in exceptional cases. These are speeds which offer no difficulty to accumulator-driven rail motors cars.

It is true of course that, owing to its higher weight, the accumulator-driven rail motor car does not particularly meet the requirements on lines with heavy gradients, seeing that its radius of action diminishes with the length and steepness of the lines. However, the electric vehicle can be made fit for service on hilly country lines. All that is required is to make the traction motors of the necessary size. As regards the reduction of the radius of action, in cases where this is really likely to interfere with the service, it can be made good by suitable measures, such as by replacing the battery, or recharging it between two runs, and by the use of a device for regenerating current, for which there are already designs which are satisfactory in all respects.

Leaving this question on one side, the lines of the German State Railway Company and other railways run for the most part over flat country. If we consider that the internal combustion rail motor car is better for districts with heavily graded lines, nonetheless there are large possibilites for using accumulator-driven rail motor cars in flat districts. We have, therefore, the possibility of using the two types of rolling stock according to the conditions. It is true that, up to the present, accumulator-driven rail motor cars in service on the German State Railway Company's lines are built on out of date lines, and mostly have too small motors; yet they have given excellent results on hilly lines in spite of their high weight : their use has in no way been limited to flat lines. Now, if these vehicles, which have been used up to the present, have been very often used on hilly lines, the new vehicles of lighter construction and better design will be able to do so even better, the more so as the weight of the batteries has recently been still further reduced.

In addition, it is possible to shorten very appreciably the time required to charge the batteries by using suitable methods, such as the use of the high charging rate under constant voltage (1) (with this method it is possible to charge in 20 minutes about 30 %, in 40 minutes about 60 %, and in 80 minutes about 80 % of a completely discharged battery) or of the accelerated charge with much higher initial current, as well as the improvement of the arrangement for charging on the vehicle itself (use of equipment for picking up current, at the charging posts or in the station, on rails which are carried above or below the vehicle; arrangements of this type are used in Ireland on the new rail motor coaches).

The fact that the rail motor car depends upon a charging station does not constitute a serious drawback, as may be supposed. Nowadays charging current suitable for this purpose is available everywhere. It is, moreover possible to make the accumulator-driven vehicles independent by fitting them with charging equipment which consists of a small Diesel or petrol motor coupled to a dynamo and carried on a frame under the vehicle or placed on the vehicle in a suitable place. In this way the absolute reliability of the rail motor car is in no way affected, thanks to the reserve of energy which is present in the large battery. Another advantage of having charging equipment on the vehicle itself is that the radius of action of the rail motor coach is increased to an almost unlimited extend. In this case again, it is possible to provide a method of regeneration of current. This charging equipment only requires relatively small generating sets, i.e. in particular the internal combustion motors can be easily and readily replaced.

A mixed motor mechanism of this sort should be considered as a very neat solution — and eminently rational under present conditions — of the problem which consists in using for railway service the very highly perfected internal combustion motor with its very cheaply generated energy, but without those of its properties which have an unfavourable effect when the motor is applied to the driving of rail vehicles.

In his lecture at the International Electricty Congress in Paris, Mr. Lo Balbo finally mentioned, with reason, the advantage the accumulator-driven rail motor car has of being capable of use as « forerunner » of the ultimate electrification, in the sense that the same vehicles could be used after the batteries have been taken away and a current collector fitted, if the railway line were fitted with overhead trolley lines.

It is therefore necessary to consider accumulator driven rail motor cars particularly well made to solve the problem that all railways have to face. In the inevitable use of small train units, starting at frequent intervals, they will find a large field of application for passenger services, in which their advantages will be very clearly seen. All that is needed is to develop still further this type of vehicles, and the railway as well as the public will derive considerable profit from them.

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(1) *Elektrotechnische Zeitschrift*, fasc. 30 of 1932 : Dr. Lange : Über Schnellaufladung von Akkumulatorenbatterien (Note on the rapid re-charging of accumulator batteries).

[621. 135 (01. 625.14 (01 & 625. 22]

Superelevation and maximum speeds as a function of the radius of curves and of the gradients of normal track,

by D. E. PROTOPAPADAKIS,

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The maximum unit accelerations

$$\frac{V^2_{max}}{12.96 \cdot \rho} - \frac{h}{153} = a_e \quad . \quad . \quad . \quad . \quad (1)$$

and

$$\frac{h}{153} - \frac{V^2_{min}}{12.96 \cdot \rho} = a_i \quad . \quad . \quad . \quad . \quad (2)$$

act, from the inside to the outside of the track, in parallel to its plane, almost at the top of the head of the rail. The acceleration a_e acts on the outer rail, having the larger radius, and occurs at the maximum speed V_{max} worked to; the acceleration a_i acts on the inner rail and at the minimum train working speed V_{min}.

If we fix, once and for all, the value of each of these accelerations and that of the minimum speed V_{min}, we can deduce the speed V_{max} and the superelevation h by means of the general formulæ :

$$V_{max} = \sqrt{12.96\,(a_e + a_i) \cdot \rho + V^2_{min}} \quad . \quad (3)$$

$$h = 153 a_i + 11.80 \frac{V^2_{min}}{\rho} \quad . \quad . \quad . \quad . \quad (4)$$

readily obtained from fromulæ (1) and (2).

In these formulæ we express :

the speeds in km. per hour,
the unit accelerations in metres per second per second,
the radius ρ of the curve in metres,
the superelevation h in millimetres.

From formula (3) we find that the speed V_{max} increases with the three factors $a_e + a_i$, ρ and V_{min} without being influenced by the ratio $a_i : a$. For example, when $V_{min} = 35$ km. (21.7 miles) and $\rho = 800$ metres (40 chains), we have to make $a_e + a_i = 1.271$ for the speed $V_{max} = 120$ km. (74.6 miles) and to make $a_e + a_i =$ only 0.75 for the speed $V_{max} = 95$ km. (59 miles).

The superelevations corresponding to the above speeds are known when, having fixed the sum $a_e + a_i$, we also fix the value of a_e or a_i; thus for $a_e = 40$, we obtain $h = 151$ mm. and 87 mm. for the speeds mentioned above.

Equation (4) shows that the superelevation h diminishes as the factors a_i and V_{min} become smaller and that, on the contrary, it increases when ρ is reduced. It is therefore desirable to use as small values of a_i as possible, and the largest values of ρ; formula (3) shows that a reduction of V_{min} is not wanted, and it is also against the interests of the slow goods service, the speed V_{min} of which always tends to increase. We imagine, moreover, that the advantages of small superelevations are sufficiently well known for us not to stress them.

Railway practice for both the individual and relative values of the factors V_{max}, h, V_{min}, a_e, a_i, $a_i : a_e$, $a_e + a_i$, etc., for a given common radius ρ shows differences which are hard to justify. These differences are found, moreover, on neighbouring systems.

The following table brings out these differences very clearly; we have drawn it by taking a curve of 800 m. (40 chains) radius and a speed V_{max} = 35 km. (21.7 miles) on various main lines and adding the results that would be obtained according to the proposals of Messrs. H. Baumann and F. Jaehn [1] at the recent International Railway Congress, and those given by the equations (3) and (4).

RAILWAY.	ρ metres (*chains*)	V_{max} km. (*miles*) per hour.	V_{min} km. (*miles*) per hour.	h millim. (*inches*)	a_e metres (*feet*) per sec².	a_i metres (*feet*) per sec².	$a_i : a_e$	Taking as units the values of a_e and a_i used on the French Est Railway.	
								a_e	a_i
French Est	800 (*40*)	120 (*74.6*)	35 (*21.7*)	148 (*5 53/64*)	0.42 (*1.38*)	0.85 (*2.79*)	2.02	1.0	1.0
Paris-Lyons-Mediterranean.	800 (*40*)	120 (*74.6*)	35 (*21.7*)	160 (*6 5/16*)	0.34 (*1.11*)	0.93 (*3.05*)	2.74	1.24	0.83
Paris-Orleans.	800 (*40*)	120 (*74.6*)	35 (*21.7*)	106 (*4 5/32*)	0.70 (*2.29*)	0.58 (*1.90*)	0.83	1.67	0.68
Italian State.	800 (*40*)	120 (*74.6*)	35 (*21.7*)	120 (*4 45/64*)	0.60 (*1.96*)	0.67 (*2.20*)	1.11	1.43	1.91
German State	800 (*40*)	95 (*59.0*)	35 (*21.7*)	60 (*2 23/64*)	0.48 (*1.57*)	0.27 (*0.88*)	0.56	1.14	0.32
* * *									
According to Messrs. Baumann and Jaehn	800 (*40*)	106 (*65.9*)	35 (*21.7*)	142 (*5 19/32*)	0.15 (*0.49*)	0.81 (*2.66*)	5.40	0.37	0.95
According to formulæ (3) and (4)	800 (*40*)	95 (*59.0*)	35 (*21.7*)	87 (*3 7/16*)	0.30 (*0.98*)	0.45 (*1.48*)	1.50	0.71	0.53

This table shows :

1. That the speed V_{max} allowable on a curve of 800 m. (40 chains) is 120 km. (74.6 miles) in the case of the four first railway systems; 95 km. (59 miles) on the German State Railways according to the equations (3) and (4) and 106 km. (65.9 miles) according to Messrs. Baumann and Jaehn.

2. That the necessary superelevations can be 60 to 160 mm. (2 23/64 to 6 5/16 inches) on the same curve; and for the same speed [120 km. (74.6 miles)], 106 to 160 mm. (4 5/32 to 6 5/16 inches);

3. That the acceleration a_e can vary from 0.15 to 0.70 (0.49 ft. to 2.29 ft. per sec. per sec.) and a_i from 0 27 to 0.93 (0.88 ft. to 3.05 ft. per sec. per sec.);

4. That the ratio a_i : a can vary from 0.56 to 5.40, etc.

Values to be adopted for a_e and a_i. — In their remarkable report, Messrs. Baumann and Jaehn propose 0.40 as the maximum normal value of a_e and as the exceptional maximum value, 0.60 (the latter for non-superelevated curves on the running lines and branches); they propose as superelevation formula $h = 8 \frac{V^2}{\rho}$

(1) See *Bulletin of the International Railway Congress Association*, December 1932, page 2251.

$+ 30$, and a speed V_{max} lying between $3.74\sqrt{\rho}$ and $3.87\sqrt{\rho}$, i. e. a mean V_{max} $3.8\sqrt{\rho}$. They confirm that these values satisfy :

1. Safety in working for locomotives with a high centre of gravity up to 2.10 m. (6 ft. 10 33/64 in.) above rail level;

2. Stability of the vehicles when running; and

3. Economy in service owing to the reduction in lateral wear of the outer rail.

As a result of these statements, we think the values $a_e = 0.30$ (0.98 ft. per sec²) and $a_i = 0.45$ (1.48 ft. per sec²) can be proposed. The greater importance is given thereby to high-speed service without going to the extreme values 0.93 and 0.27 (3.05 and 0.88 ft. per sec²) used by the Paris-Lyons-Mediterranean Railways and the German State Railways for a_i, nor to those of 0.70 and 0.15 (2.29 and 0.49 ft. per sec²) used by the Paris-Orleans Railway and the above quoted authors for a_e.

Value to be adopted for V_{min}. — For main lines we estimate that V_{min} should be taken as equal to 35 km. (21.7 miles), the speed imposed, on mobilisation, on all trains. For lines with heavy gradients $V_{min} = 25$ km. (15.5 miles) must be allowed, and even 20 km. (12.4 miles) on very difficult lines, especially on up gradients.

Results given by equations (3) and (4). — With the above values of $a_e = 0.30$ (0.98 ft. per sec²) and $a_i = 0.45$ (1.48 ft. per sec²) and $V_{min} = 35$ km. (21.7 miles), and rounding off the figures, we suggest equations (3′) and (4′), obtained from (3) and (4) for calculating the maximum speed V_{max} and the corresponding superelevation h to be allowed on a curve of radius ρ :

$$V_{max} = 3.10\sqrt{\rho + 140} \quad . \quad . \quad . \quad (3')$$

$$h - 70 + \frac{14\,000}{\rho} \quad . \quad . \quad . \quad . \quad . \quad (4')$$

The results given by these formulæ for $\rho = 300$ to 1 400 m. (15 to 70 chains) are given in the table hereafter.

In the case of non-superelevated curves of radius $\rho <$ 250 m. (< 12.5 chains) the speed V_{max} is calculated from equation (1) by making $h = 0$ and $a_e = 0.60$ (1.96 ft. per sec²); we then obtain $V_{max} =$ 37 or 40 for curves of 180 and 200 m.

Results obtained from equations

ρ =	300 m. (*15 ch.*)	400 m. (*20 ch.*)	500 m. (*25 ch.*)	600 m. (*30 ch.*)	700 m. (*35 ch.*)
i_{mm} =	20 (*1 in 50*)	17.75 (*1 in 56*)	15.55 (*1 in 64*)	13.33 (*1 in 75*)	11.11 (*1 in 99*)
V_{max} =	65 km. (*40.4 m.*)	72 km. (*44.7 m.*)	78 km. (*48.5 m.*)	84 km. (*52.2 m.*)	90 km. (*55.9 m.*)
h_{mm} =	117 mm. (*4 19/32 in.*)	105 mm. (*4 1/8 in.*)	98 mm. (*3 55/64 in.*)	94 mm. (*3 45/64 in.*)	90 mm. (*3 35/64 in.*)

(23.0 or 24.85 miles for curves of 9 and 10 chains) radius. If these curves can be superelevated V_{max} and h are calculated by equations (3′) and (4′).

The speeds obtained by means of equation (3′) are almost the same as those used by the German Railways until recently, while the superelevation given by equation (4′) exceed those of the German Railways by 6 % to 80 % (see *Hütte*, Vol. III, page 756, German edition of 1928). Equation (4′) cannot, therefore, be said to give small superelevations.

It is of course understood that the values of $a_e + a_i = 0.75$, $a_e = 0.30$, $a_i = 0.45$ and $V_{min} = 35$ km., adopted above, are in no way absolute, but can be modified within limits narrower than those of the above table. When estimating these values, we intentionally took a value for the acceleration a_e below the maximum normal value of 0.40 proposed by Messrs. Baumann and Jaehn, and for a_i of only 3/4 the exceptional maximum value of 0.60 laid down by the same authors for curves without superelevation. By means of these values, we believe we obtain the following results :

1. A happy medium from the point of view of the greater importance that must be given to the safety of fast trains relatively to slow trains.

2. Moderate and less daring speeds than those allowed on 750 and 800-m. (37 1/2 and 40 chains) radius curves on the French Railways.

3. More equal wear of the two files of rails; it must not be forgotten that the side wear of the outer rail can be due equally well to the fast trains owing to lack of superelevation and to the slow trains through excess superelevation.

Gradients. — As is well known, the gradients of the lines limit the speed both when ascending and when descending them. When surveying a line, care must be taken to work in the curves with the gradients so that the speed V_{max}, allowed on the curves in question in terms of their radius, may correspond to that allowed on the gradient. From this point of view, we suggest the equation :

$$\rho = 1200 - 45i \quad \ldots\ldots \quad (5)$$

which corresponds to

$$V_{max} = 20.83\sqrt{29.78 - i} \quad \ldots \quad (6)$$

or, rounding off the figures, to

$$V_{max} = 20.80\sqrt{29.80 - i} \quad \ldots \quad (6')$$

Equation (6) gives almost the same speeds as equation (3′).

3′), (4′), (5) and (6′).

800 m. (*40 ch.*)	900 m. (*45 ch.*)	1 000 m. (*50 ch.*)	1 100 m. (*55 ch.*)	1 200 m. (*60 ch.*)	1 300 m. (*65 ch.*)	1 400 m. (*70 ch.*)
8.88 (*1 in 113*)	6.67 (*1 in 150*)	4.44 (*1 in 225*)	2.22 (*1 in 450*)	∞	∞	∞
95 km. (*59.0 m.*)	101 km. (*62.8 m.*)	105 km. (*65.2 m.*)	109 km. (*67.7 m.*)	114 km. (*70.8 m.*)	118 km. (*73.3 m.*)	122 km. (*75.8 m.*)
87 mm. (*3 7/16 in.*)	86 mm. (*3 25/64 in.*)	84 mm. (*3 5/16 in.*)	83 mm. (*3 9/32 in.*)	82 mm. (*3 15/64 in.*)	81 mm. (*3 13/64 in.*)	80 mm. (*3 5/32 in.*)

Athens, 15 June 1933.

[621. 133.1 (.43)]

Trials with pulverised coal on locomotives of the German State Railway Company,

by Fr. WITTE, Diplomingenieur, Reichsbahnrat, Berlin.

(*Zeitung des Vereins Deutscher Eisenbahnverwaltungen*, nº 31, 1932.)

When in 1926-1927, while carrying out a large experimental programme the object of which was to clear up the question of the rational and profitable application to the steam locomotive of the improvements made in the construction of stationary engines, the German State Railway Company came to consider the evolution of locomotive firing, it had two main guiding principles in mind. The first of these was the desire to reduce the locomotive running costs by using fuel which, so far, on account of its low thermal value, had not been usable on high-power locomotives, but which, owing to its price, presented some advantage compared with coal of good quality. It was well known, it is true, that the average annual expenditure for fuel for a locomotive is such that for savings of 10 to 20 %, the additional capital charges this technical innovation would naturally involve, could not exceed a given amount.

It was, however, considered permissible to think that the cost of producing a coal dust suitable for locomotive fuel could be obviated by using the dust from the screens collected in quite large quantities when manufacturing lignite briquettes, and this possibility in any case justified a trial. The second reason for making the trial was the desire to solve the technical and scientific problem which includes the questions relating to the essential difference which exists between the locomotive boiler and stationary boilers, and in particular that of the small dimensions of the firebox. In this way not only would the question of firing with pulverised fuel have been carried a stage forward, but at the same time the mechanisation of firing would have been tackled from a new angle.

Although at the time the trials with pulverised fuel were carried out, the locomotives of the German Railways had not become too large to be fired by hand, with coal of good quality, of course, the heavy 1 E locomotives of classes 43/44 and the express locomotives of classes 01 and 02 already had boilers which, with their grate area of 4.50 m² (48.4 sq. feet) represent, at high rates of combustion, the limit of hand firing, especially on long non-stop runs.

The fuel proposed for the trials was necessarily the lignite which is found in large quantities, especially in Central Germany and in the Rhineland, as its low price, compared with coal, was of itself sufficiently attractive. In addition, the question of the carbonisation of coal and the use of its by-products (coke dust), on locomotives, was kept in mind. The economical transport of lignite is only compatible with a narrow area of use, and everything thus pointed to the desirability of locating the trial operations at the point of extraction of the lignite. The starting point was, therefore, the Halle Division of the German State Railway Company. At the present time, ten goods engines of classes 56 and 58, four of the former and six of the latter, are in service, which represent the different stages of evolution in

the two lots of engines delivered by the « Allgemeine Elektrizitätsgesellschaft », and the « Pulverised Fuel Development Company » represented by « Henschel und Sohn ».

As this was primarily a simple question of boilers, the firing was first of all developed at the testing plant before being applied under a modified form to a locomotive. The greatest difficulty was to obtain the necessary efficiency within the small limits of the firebox and with a system differing radically from grate firing. Whereas, in the latter arrangement, the air gets to the firebox after passing through the bed of fuel, and the coal burns while remaining on the grate, when firing with pulverised fuel the extremely finely divided dust is mixed with the air which carries it, and burnt. Now the container in which combustion takes place, i. e. the firebox, limits, by its volume, the distance within which the particles must be completely burnt. Moreover, the unburnt residue must be sufficiently cooled down before it comes into contact with the tube plates for it not to adhere thereto. Finally at equal evaporation rate, the weight of coal burnt is approximately inversely proportional to the respective calorific value of lignite and coal. These facts combined to make difficult the solution of the problem.

All these questions were only solved by an appropriate design of the burner, of the combustion chamber — as regards its brickwork, the form being ascertained as well as the other features — and, in a very essential way, by the direction given to the combustion air jet. The two groups of manufacturers who took part in the development work commenced by following quite different directions, firstly as regards the design of the burner, and secondly and chiefly as regards the air supply. It was soon realised that the latter is the decisive factor, the design of the burner being of smaller importance. The « Allgemeine Elektrizitätsgesellschaft » (A. E. G.) uses a burner placed under the side walls of the firebox with vertical slots and directing vanes for guiding the flame; the « Pulverised Fuel Development Company » uses burner plates, with a large number of nozzle-shaped openings, carried under the firebox back plate. The two patterns are intended to divide up as much as possible the mixture of fuel and air. Practical experience has shown that they are equally good from the point of view of combustion, but that, as the burner plate of the « Pulverised Fuel Development Company » is the simpler, it is to be preferred on account of its lower cost.

The brickwork of the fireboxes and, closely bound up therewith, the guiding of the combustion air, have undergone various alterations in the course of the trials. However, it can now be definitely stated that the division into one main portion which at the same time carries with it the fuel dust and which enters through the burner, and into a secondary portion which is supplied through a vertical pipe under the firebox arch, i. e. that is drawn in in the simplest way by the action of the blast, forms the most rational solution of the problem. At the same time, secondary air supplies at the front end of the combustion chamber to hinder the first backfiring of the flame, and through the fire hole door as a protection against the second backfiring, have shown their usefulness in getting complete combustion and reducing the deposit on the tube plate. However, these arrangements have not prevented the confined limits in which combustion has to take place from imposing a degree of fineness which the pulverised fuel must reach. This limit is represented by a residue of 20 to 25 % on a 4 900-mesh screen. In the case of both existing locomotives and new constructions, the small firebox volume must be taken into consideration, as any appreciable alteration of this part of the engine would involve a rapidly inceasing additional capital

cost. This increase in first cost is justified in no case, as we shall show by the results obtained. The limit of fineness can be observed by simple means, as long as the use of dust from the screens is concerned.

As regards the design of the tender, the necessary supply of fuel dust which has the extremely low specific weight of 0.4 to 0.6, the conveyance of the dust to the firebox, and the production of the primary air supply govern the form to be adopted. On the first rebuilt locomotives, the feed of the dust and that of the primary air were controlled separately, so that there were two auxiliary steam engines on the tender. In the end, the heavy steam consumption of these auxiliary engines and the necessary limitation of expenditure, led to the idea of a common drive of the screw conveyor feeding the fuel and of the fan so as to get proper co-ordination. It was originally thought that an auxiliary burner was essential to make good losses when standing. By abandoning the independent drive of the primary air fan, it was found that with two burners, the main flame could be quite satisfactorily controlled. As the brickwork remains hot a long time, a fire can be easily lighted up by throwing a few logs of wood into the firebox.

The design shown in figure 1 (longitudinal section) was the outcome of all the practical tests. The fan and the auxiliary engine are arranged along the top of the tender (rear end) so that any noise is hardly heard by the driver and fireman. The vertical shaft driving the screw conveyor is located here as well. The primary air is driven along the axis of the screw, so that the dust leaving the screw is picked up in an annular opening and carried on.

Fig. 1.

As, depending upon the composition of the dust and especially upon how heavily the boiler is being worked at the time, a deposit of clinker and unburnt residues collects on the tube plate, a sand jet is fitted on the back plate by means of which the deposit can be cleaned off. The deposit detached from the tube plate falls into a special container in front of the secondary air channel.

Furthermore, when the problem of the combustion properly speaking had been solved, all the advantages claimed for pulverised fuel firing which resulted in its adoption on stationary boilers were really obtained on the locomotive : easy driving, great reduction in the work required of the enginemen, good adaptabilty to variations in traffic, suppression of the heavy work consisting in cleaning the grate, and rapidity in raising steam. The results of tests in traffic (table 1) show, moreover, the improvements obtained as regards thermal efficiency.

TABLE 1.

Results of tests of locomotives fired with pulverised coal under constant working conditions at 40 km. (25 miles) an hour (Class 58 locomotives).

—	First type. Pulv. Fuel Develop[t] Co's system.	2nd type A. E. G. system.	2nd type Pulv. Fuel. Develop[t]. Co.	Grate fired locomotive.	Remarks.
Minimum value of fuel consumed per H. P.-hour . . . . . . kgr. (*lb.*).	8.55 (*18.85*)	7.50 (*16.53*)	8.20 (*18.08*)	8.50 (*18.74*)	
Specific consumption of heat in the steam from 0° C. (32° F.). Calories (*B. T. U.*) per H. P.-hour.	6 550 (*25 990*)	5 780 (*22 935*)	6 200 (*24 600*)	6 500 (*25 790*)	
Minimum specific consumption of heat in the fuel. Calories (*B. T. U.*) per H. P.-hour.	7 500 (*29 760*)	6 750 (*26 780*)	7 100 (*28 170*)	7 600 (*30 160*)	The values correspond to different powers, the peaks of the curves being displaced relatively to one another.
Superheat temperature for an evaporation of 60 kgr. per m² (12.3 lb. per sq. foot). Degrees C. (*degrees F.*).	400 (*752*)	406 (*762.8*)	390 (*734*)	376 (*708.8*)	
Efficiency of the boiler, maximum value and minimum value. . . %	77.5—75	81—74	77.5—75	77.5—70	
Steam consumption of the auxiliary engines . . . . kgr. (*lb.*).	400—475 (*882—1 047*)	300—400 (*661—882*)	200—400 (*441—882*)	...	
Steam consumption of the auxiliary engines as a percentage of the evaporation at the limit of capacity of the boiler . . . . %	6.25	3	3.7	...	
Maximum horse power	1 560	1 475	1 440	1 3?0	
Specific consumption of coal per H. P.-hour. . . . . . . kgr. (*lb.*).	1.44 kgr. for 5 200 cal. (*3.17 lb. for 10 317 B. T. U.*)	1.28 kgr. for 5 200 cal. (*2.82 lb. for 10 317 B. T. U*).	1.36 kgr. for 5 200 cal. (*3.00 lb. for 10 317 B. T. U.*)	1.08 kgr. for 7 000 cal. (*238 lb. for 13 883 B. T. U.*)	

We do not think it necessary to give the figures for the Class 56 engines as, on the one hand, these were the only engines fitted on the A. E. G. system and, on the other, owing to their short boilers, while they lent themselves well to the alterations from a working point of view, they did not from the point of thermal efficiency.

The figures reproduced show, for example, that simply altering the supply of primary air on the first engines of the « Pulverised Fuel Development Company » by adding the secondary air in the second type, considerably reduced the steam consumption by the auxiliaries. Compared with the grate-fired locomotives, we obtained, from boilers of the same dimensions, an increase in the superheat temperatures and an improved boiler efficiency, and therefore an increase in the power of the locomotive corresponding to the limit of capacity of the boiler, i. e. to the maximum allow-

TABLE. 2 — **Results obtained in service wit**

—	Locomotive fired with pulverised fuel, A. E. G. system. 56 2130 56 2801		Locomotive co
Period.	May-Dec. 1930	July-Sept. 1931	May-Dec. 193
Fuel consumption, Metric tons per 1 000 loco.-km. (*English tons per 1 000 loco.-miles*)	24.24 (*38.52*)	28 (*44.50*)	13.50 (*21.45*
Ratio : lignite to coal	1.8	1.9	...
Fuel consumption, Metric tons per 1 million tkm. (*Engl. tons per 1 million of Engl. ton-miles*) hauled	33.17 (*53.38*)	37 (*59.54*)	19.92 (*32.06*
Ratio : lignite to coal	1.7	1.8	...
Expenditure, in Reichsmarks, per 1 000 loco-km. (*per 1 000 loco-miles*) :			
a) Fuel	346 (*556.8*)	398 (*640.5*)	378 (*608.3*)
b) Lubricants	6 (*9.6*)	...	4 (*6.4*)
c) Driving wages.	7 (*11.3*)	11 (*17.7*)	10 (*16.1*)
d) Maintenance of locomotive	33 (*53.1*)	20 (*32.2*)	11 (*17.7*)
e) Stores.	15 (*24.2*)	22 (*35.4*)	...
Total. . .	407 (*655.0*)	451 (*725.8*)	403 (*648.5*
Expenditure, in Reichsmarks, per 1 million tkm. (*per 1 million of English ton-miles*) hauled :			
a) Fuel	474 (*775.0*)	521 (*851.8*)	558 (*912.3*
b) Lubricants	8 (*13.1*)	...	6 (*9.8*)
c) Driving wages.	10 (*16.3*)	14 (*22.9*)	14 (*22.9*)
d) Maintenance of locomotive	45 (*73.6*)	26 (*42.5*)	17 (*27.8*)
e) Stores.	20 (*32.7*)	29 (*47.4*)	...
Total. . .	557 (*210.7*)	590 (*964.6*)	595 (*972.8*
Saving per 1 000 loco-km. (*per 1 000 loco-miles*) when fired with pulverised fuel as compared with the total expenditure when grate-fired with coal, %	...	...	...
Saving per 1 million tonne-kilometres hauled with the pulverised fuel fired locomotive as compared with the total expenditure of the coal grate-fired locomotive, %	6	...	...
Cost of fuel including carriage charges, loaded on to tender.	13.10 Rm. ÷ 14.11 t. (*13.89 Engl. tons according to colliery*).	14.11 t. (*13.89 Engl. tons*).	28.00 Rm. ...
Average weight of the train { Metric tons . . . . (*English tons*)	731 (*719.4*)	765 (*752.9*)	678 (*667.3*)

comotives fired with pulverised fuel.

e same type, ed.	Locomotive fired with pulverised fuel, A. E. G. system. 58 1416 58 1894		Locomotive fired with pulverised fuel, Pulv. Fuel Devel. Co. 58 1353 58 1677 58 1722		Comparative coal fired locomotive.	
uly-Sept. 1931	May-Dec. 1930	July-Sept. 1931	May-Dec. 1930	July-Sept. 1931	May-Dec. 1930	July-Sept. 1931
15 (*23.84*)	28.71 (*45.62*)	29 (*46.08*)	28.63 (*45.49*)	31 (*49.26*)	17.31 (*27.41*)	20 (*31.68*)
...		1.5	1.7	1.6	...	...
21 (*33.79*)	36.22 (*58.29*)	34 (*54.72*)	36.73 (*59.11*)	35 (*56.32*)	22.71 (*36.55*)	22 (*32.18*)
...	1.6	1.5	1.6	1.6	...	...
403 (*648.5*) ... 8 (*12.9*) 5 (*8.0*) 1 (*0.6*)	417 (*671.1*) 7 (*11.3*) 11 (*17.7*) 43 (*69.2*) 17 (*27.4*)	414 (*666.2*) ... 12 (*19.3*) 16 (*25.7*) 21 (*33.8*)	413 (*664.6*) 8 (*12.9*) 9 (*14.5*) 45 (*72.4*) 24 (*38.6*)	435 (*700.0*) ... 12 (*19.3*) 22 (*35.4*) 24 (*38.6*)	485 (*780.5*) 7 (*11.3*) 10 (*16.1*) 24 (*38.6*) ...	512 (*823.9*) ... 8 (*12.9*) 3 (*4.8*) 2 (*3.2*)
417 (*670.0*)	495 (*796.7*)	463 (*745.0*)	499 (*803.1*)	493 (*793.3*)	526 (*846.5*)	525 (*844.8*)
544 (*889.4*) ... 11 (*18.0*) 7 (*11.4*) 2 (*3.3*)	526 (*860.0*) 9 (*14.7*) 14 (*22.9*) 54 (*88.3*) 22 (*36.0*)	474 (*775.0*) ... 14 (*22.9*) 18 (*29.4*) 24 (*39.2*)	530 (*866.5*) 10 (*16.3*) 12 (*19.6*) 58 (*94.8*) 31 (*50.7*)	490 (*801.1*) ... 13 (*21.2*) 25 (*40.9*) 28 (*45.8*)	636 (*1039.9*) 9 (*14.7*) 13 (*21.2*) 32 (*52.3*) ...	579 (*946.6*) ... 9 (*14.7*) 3 (*4.9*) 2 (*3.3*)
564 (*922.1*)	625 (*1021.9*)	530 (*866.5*)	641 (*1047.9*)	556 (*1009.0*)	690 (*1128.1*)	593 (*969.5*)
...	6	12	5	6	...	...
...	9	11	7	6	...	...
26.10 t. (*25.69 Engl. tons*).	13.10 Rm. — 14.11 t. (*13.89 Engl. tons*).	14.11 t. (*13.89 Engl. tons*).	13.10 Rm. — 14.11 t. (*13.89 Engl. tons*).	14.11 t. (*13.89 Engl. tons*).	28.00 Rm. ...	26.10 t. (*25.69 Engl. tons*).
741 (*729.3*)	791 (*778.5*)	872 (*858.2*)	748 (*736.2*)	889 (*874.9*)	762 (*750.0*)	884 (*870.0*)

able evaporation of about 60 kgr. per m^2 (12.3 lb. per sq. foot) per hour. As the increase in consumption due to the auxiliaries was made up by the improved thermal efficiency, the marked difference in price between the two fuels in question, lignite and coal, resulted in a reduction in the operating costs.

As soon as the controlled trials were completed, the locomotives were allotted to regular goods trains working under the Halle depot, so as to ascertain their relative efficiency as compared with grate-fired locomotives. If we allow the same consumption of heat per unit of power, the ratio of 2 to 1 which existed between the prices at the time of the trials promised an appreciable saving, even when the capital charges due to the fitting up of the locomotives were taken into consideration, unless high costs of repairs absorbed the savings. Naturally at first costs of this kind were expected to increase owing to the novelty of the equipment and the new method of firing. But as in the meantime the working has become a routine one, some idea of the results obtained in two periods of the years 1930 and 1931 can already be formed (table 2). Here again, the numerical values enable us to recognise, especially by the variation in the repair costs, the way the new system progressively adapted itself to the working.

If, for the moment, only the operating costs properly speaking be considered, i. e. excluding capital charges, we find a marked saving which, at the beginning, is diminished by the supplementary costs for pulverised fuel firing due to the experimental nature of the working. These costs are principally due to brickwork renewals. When considering, for comparative purposes, the numerical values, the monthly distances run by the locomotives used in the trials, 8 000 to 9 000 km. (5 000 to 5 600 miles) for example, represent a good average. If to the operating cost are added the capital cost required up to the present for the alteration, taking an expenditure of 18 000 Rm. as the basis for the pulverised fuel equipment (standard equipment), a part of the rebuilding costs being counted as the cost of overhaul chargeable to ordinary maintenance, we find an additional expenditure of 40 to 45 Rm. per 1 000 locomotive-km. (66 to 72.5 Rm. per 1 000 locomotive-miles). Naturally, the capital charge due to the first alteration of a number of trial locomotives, based on the actual cost of the alteration, is appreciably higher. But this ought not to be taken into account in getting out the valuation. For this purpose, the probable standard equipment must be used as the basis. If the additional capital charge has the effect of a heavy reduction of the real saving in operating costs, this is due first of all to the reduction in the price of lignite dust not following sufficiently closely that occurring in the meantime in the price of coal. As compared with 1930, the cost of coal on tenders has fallen about 7 %, while the price of lignite dust has not shown the same drop. The frequently observed tendency of prices of materials to advance when a new outlet is found, as for example in the present case of lignite, has therefore again opened the question of the possibility (remarkable from an economical point of view) of the utilisation of fuel of inferior quality in railway service : whereas the technical problems have been solved, the financial difficulties have been increased by the difference in the price variation.

In the case of the relatively restricted trials carried out at Halle, the question of supplying coal to the locomotives was dealt with in an improvised manner. Fixed plant for discharging by compressed air the dust brought in special wagons directly into the tenders was considered all that was necessary. In this way the cost of erecting the plant was reduced to the minimum. The costs of

this operation are included in the operating costs in table 2. As for a large-scale alteration, these costs are, it is true, appreciably increased by the provision of special pulverising plant for making the dust, and of silos, the financial advantages are considerably reduced, as we must suppose that the price quoted in the table can be maintained for dust produced in a special pulverising plant. The situation is obviously different, when in the absence of deposits in a given country, coal has to be imported, while coal of inferior quality is available, which is quite suitable for firing as pulverised fuel. In this case, according to information so far available, the alteration would undoubtedly be profitable. Very detailed information which can be used when analysing all the factors to be taken into account when checking the economical value of a system, is given by Mr. Rosenthal, of the German State Railway Company, in his report to the 2nd World Power Conference (vol. XVII).

The reason why, under the relatively favourable conditions under which the experimental work of the German State Railway Company is conducted, the basis of the trials was not enlarged, is not so much to be found in the economics of the question as in a remarkable technical matter arising during the trials. The rather old copper firebox of the altered locomotives showed, after some time in service, corrosion of the stayheads and side plates, and it was finally necessary to consider the replacement of the firebox. The first examination of the deposits has so far failed to elucidate the matter completely, but it is possible that the cause is due to the mechanical attack of the surface by the flame, and the solid particles that it holds in suspension, as well as in the composition of the fuel. There is no doubt but that the sulphur content of the lignite, although the percentage is frequently less than in the coal burnt in the same box, has an unfavourable effect on the copper walls as during combustion, its action takes place in a quite different and intensive way, and sometimes too, under unfavourable chemical combinations.

As the copper fireboxes can be replaced economically by the mild steel fireboxes widely and successfully used in recent years on the German State Railway Company, for which the best materials and the type of stays to be used are now known, fireboxes with smooth sides in J Z steel with drifted stays and roof of the same material were fitted when carrying out extensive repairs to the first locomotives. The results obtained so far appear to show that, with the new material, no firebox corrosion will occur.

Tests made with coke dust have so far shown difficulties in the way of maintaining for a lengthy period the maximum evaporating capacity of the boiler without considerable deposit on the tube plates. As the experiments relating to the correct adjustment of the air supply and other factors are difficult to carry out in service, the tests are being carried out on the testing plant of the « Pulverised Fuel Development Company ».

From the technical point of view, the problem of firing locomotives with pulverised fuel can be considered as solved. From the financial point of view the unfavourable level of the price of lignite dust as compared with that of coal has hindered the extension of the use of this fuel on the German State Railway Company's locomotives.

[625. 232]

Carraresi metal bellows for railway carriages.

The chief constructional feature of the Carraresi metal bellows lies in its being built up of nearly rectangular sections shaped like the frame plate.

These sections are all-metal, and the diaphragm action is obtained by securing one of the end sections to the end of the vehicle and arranging the other sections to slide telescopically one within the other.

This bellows is intended to replace the present design made of canvas or leather, with which it will couple, as the frame plate of each half bellows and the locking gear are the same.

This bellows will also couple up with those of foreign railways, including those on the International Sleeping Car Company's vehicles, which are fitted with two types, the German and the International.

Owing to the strength of the metal bellows, the supporting gear used with the different types, which is essential with the present canvas or leather bellows, can be discarded.

The degree of opening of the metal bellows is limited by one or two sets of adjusting gear fitted with springs attached to the end wall of the vehicle. The object of this adjusting gear is to keep the moveable sections of the bellows extended, so that the movement between the sections occurring on curves and gradients and due to compression and extension of the draw and buffer gear may be confined to the two sections nearest the body for each of the two half bellows coupled together.

The operation of coupling together two metal bellows is as easy to carry out as with the present pattern.

The space between sections can be filled in with strips of wood, aluminium, leather, or fibre, suitably secured all round to the outside edges of each section on the side away from the body.

The inner edge of these sections, when sliding for coupling up, comes up against the strips of the adjacent section and, as a result of the tension of the adjusting gear mentioned above, the two half bellows coupled together are hermetically sealed.

The two bottom corners of the bellows, starting with the frame plate, are rounded off to a radius of 200 mm. (7 7/8 inches), so as to clear the handbrake screw when this is fitted, and to make it easier to operate the Westinghouse brake cock and to replace the brake pipes, even when the train is formed.

These rounded-off corners entirely prevent the bellows from coming into contact with the buffers, whereas with the ordinary bellows this often occurs. The chain the International Union of Railways' regulations require to be fitted can therefore be done away with.

The advantages of the metal bellows over the canvas or leather pattern are the following. There is first of all a saving in cost : altough the cost of manufacturing the metal bellows is sligthly higher than that of canvas bellows, the difference in price appears to be largely made good by a longer life and reduced maintenance costs.

Its longer life is due to the all-metal construction throughout in all details, to the form of construction, and to its solidity.

The parts are actually entirely metal;

Fig. 1.

Fig. 2.

Coaches of the French Nord Railway. — The metal bellows is applied, using the frame plate and all existing fittings.

Fig. 3. — Coaches for the Milan-Rome-Naples expresses.

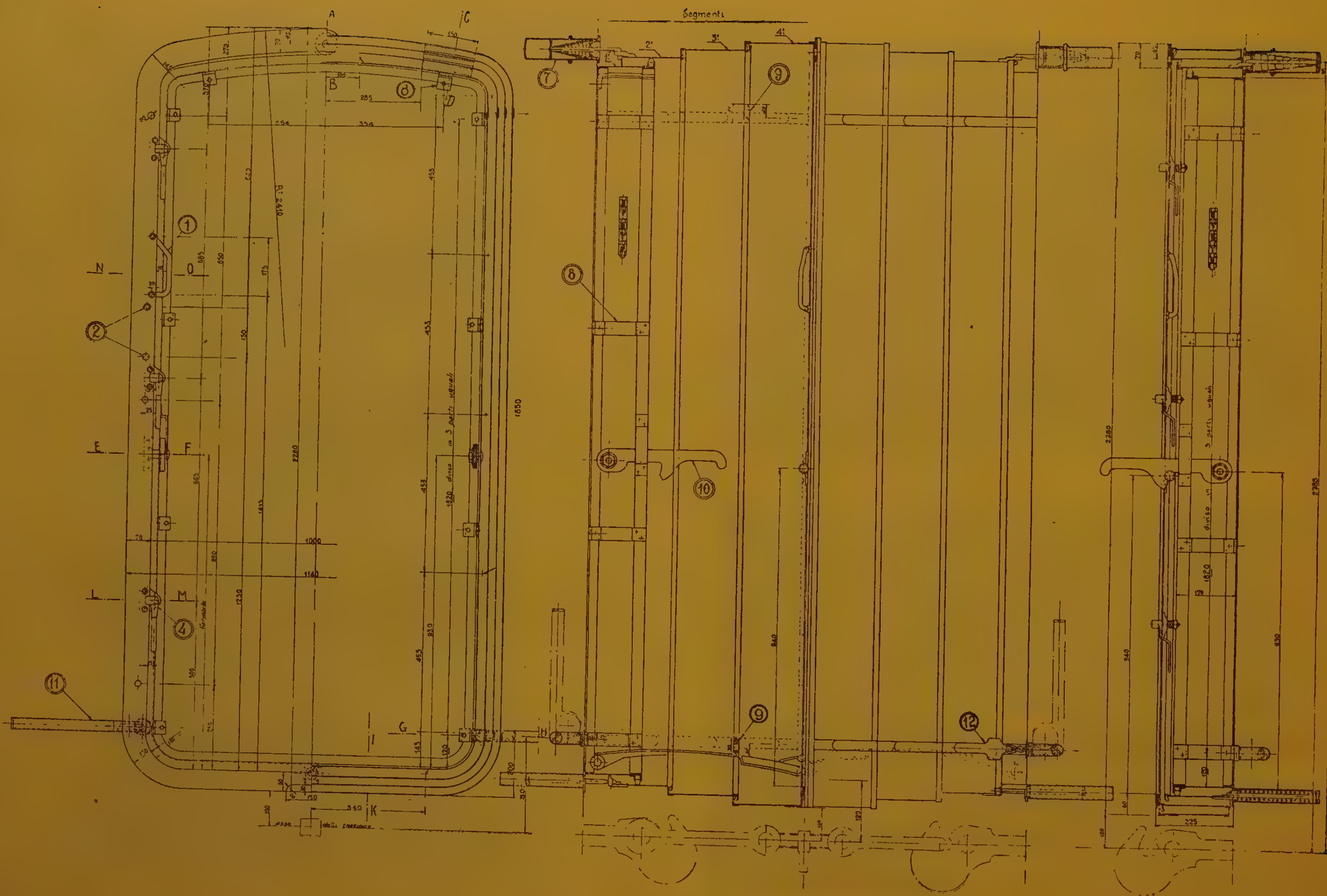


Fig. 4.

the plates for the sections can be either galvanised iron, duralumin or brass.

It will be noticed that, structurally, the sections are very simple and strong, as they simply consist of a bent plate reinforced by angles on the sides. The first section is securely bolted to the end of the vehicle, and supports the three moveable sections.

The section which is fastened to the frame plate by means of an angle piece is reinforced by this latter, and in its turn reinforces the frame so as to ensure the bellows does not get out of shape, as is so frequently the case with the present design, making it difficult to couple them and to get them to close tightly.

As any relative movement in service can only take place between the first sections, the parts most subject to wear are the slides, and the metal parts attached to the two sections in question, which parts, however, are cheap and easily renewed.

Owing to its particular form of construction, the metal bellows can be easily taken apart for repairs.

The bellows can be cleaned more easily and quickly inside and out than the present ones, as the surfaces are all plane; the bottom where dirt collects more readily is cleaned out through special cleaning holes provided.

When the metal bellows is used, the damage done to the top of the present type through burns and even fires from sparks is completely eliminated.

The metal bellows also looks more reliable. In the case of snow or rain followed by frost, the metal bellows never causes any difficulty as regards its weather tightness, whereas the ordinary canvas or leather design frequently gives trouble and suffers serious damage.

The advantage of having retained, with the metal bellows, the same frame plate and the same lock fittings as are used on the ordinary bellows in use should not be overlooked, as the railways using canvas or leather bellows wishing to replace them by metal ones can use the existing coupling frame and fittings. The average weight of a single bellows excluding the frame plate is 120 kgr. (264 lb.).

Metal bellows of the type in question have been fitted to vehicles belonging to the International Sleeping Car Company, to more than 100 vehicles belonging to the Italian State Railways, to 120 Rumanian vehicles, to a number of vehicles on the French Nord Railway, and to coaches on the German, Spanish, English and Polish railways. Some of these bellows have been in continuous service since 1924, are still in good order, and have given hardly any trouble.

They have even been used on curves of 75 m. (3 3/4 chains) radius and were not damaged in any way.

The Italian State Railway coaches fitted with metal bellows during the period have also been used as separate vehicles without the staff being given any special orders or instruction; they have been coupled, separately, in through and express trains; they have been in use for more than seven years, and apparently without any inconvenience.

In conclusion, it would seem that a more extended use of metal bellows in railway practice may be expected in view of their undoubted merits as compared with canvas or leather bellows. These advantages may be summed up as good behaviour in service, reduced maintenance, and improved aspect.

[621. 132. 3 (.42)]

New four-cylinder 4-6-2 express locomotive, London, Midland and Scottish Railway.

(*The Railway Engineer.*)

Considerable interest has been aroused by the completion at the Crewe works of the London Midland & Scottish Railway of a new express locomotive having the locomotive, No. 6200, which has single-expansion cylinders. The design for the engine was worked out in the Company's drawing office at Derby under the instructions of Mr. W. A. Stanier, Chief Mechanical Engineer. After a period of running under test conditions the locomotive, N°. 6 200, which has been named *The Princess Royal,* will shortly be placed in regular express service on the London Midland & Scottish (L.M.S.) main line.

Cylinders and motion.

The inside cylinders and motion are horizontal, the cylinders being located in a position practically central over the leading bogie wheels, whilst the outside cylinders are approximately central above the trailing bogie wheels, an arrangement which permits of an almost equal distribution of cylinder weight over the bogie wheelbase. Steam is distributed to the cylinders by piston valves 8 inches in diameter, having a valve travel of 7 1/4 inches. The steam ports from the piston valves to the cylinders are straight and, as the valves are of the inside admission type, the two separate exhaust passages for the inside cylinders are carried over the top of the steamchest and merged together at the hind end where the cylinders form the saddle casting for the front end of the smokebox. The exhaust ports of the outside cylinders are taken through the main frames to a branch casting, which also forms the saddle for the smokebox at about its centre. A further departure from previous practice is that bye-pass valves are not used as, when coasting with the gear placed at about 45 per cent cut-off, it is considered that with the efficient type of valve gear fitted, excessive compression, with its resultant trouble at the connecting rod big ends, is avoided. Cylinder drain cocks of the standard type are used, but the automatic spring loaded cylinder drain valves are of a smaller size than usual. The cylinder clearance volume is 9.4 per cent of the swept volume of the cylinders. A 16-feed standard type mechanical lubricator is fitted on the left-hand side of the engine, and this supplies superheater cylinder oil to the eight piston valve heads, the four cylinder barrels and the four piston-rod packings. In addition to these, four feeds are taken from the mechanical lubricator on the right-hand side which supplies engine oil only to the piston valve spindle guide bushes. This is in accordance with the usual practice, and as only exhaust steam is in contact with these bushes, no trouble is experienced. These guide bushes are made of phosphor bronze lined with white metal, the inside diameter being 1 7/8 inches and the length about 7 3/4 inches. Water

Fig. 1. — Side view.

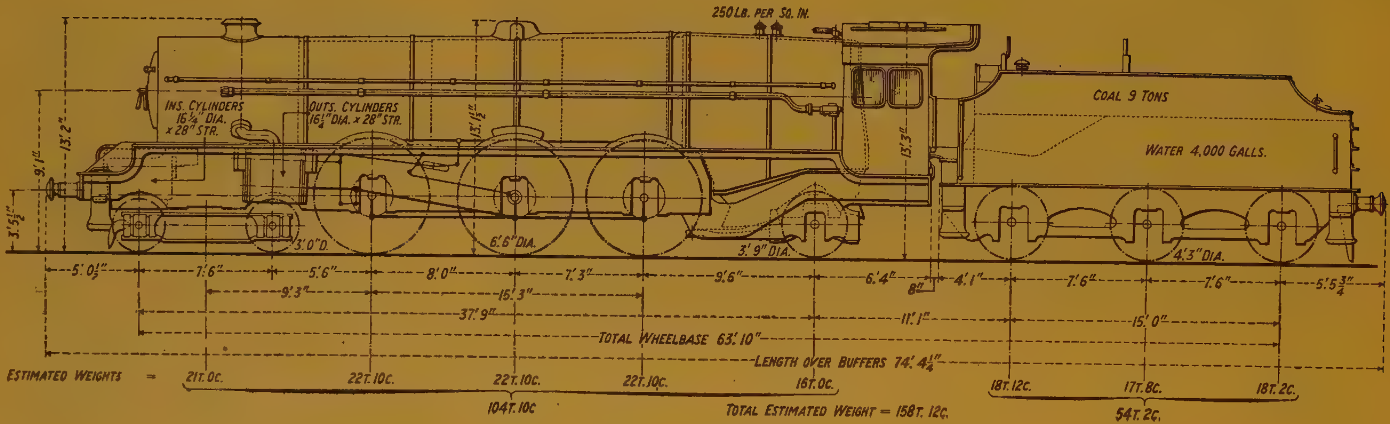


Fig. 2. — Elevation.

grooves are machined on the inside of the guide bushes.

The eight feeds to the piston valve heads and the four feeds to the cylinder barrels are combined with a steam atomiser jet operating before the lubricant arrives at the point of delivery, and in the case of the piston valves the lubrication is carried into an annular space provided in the cylinder casting behind the liners. The atomised oil passes from this cavity through six holes equally pitched round the liner so that the whole surfaces of the piston-valve liners are thoroughly lubricated. Another interesting point is that the lubricant is introduced on the live steam side of the piston valve head so that the natural flow of the steam carries it over the whole of the working surfaces of the liners and piston valves before passing on to the cylinders.

The leading particulars of the valve motion are as follow :

Throw of eccentric	9 inches.
Travel of valve	7 1/4 inches.
Lead	1/4 inch.
Lap of valve	1 3/4 inches.
Exhaust clearance	Nil.
Angle of eccentric inside gear .	98°.
Angle of eccentric outside gear.	98.15°.
Right-hand crank to lead.	

The inside and outside connecting rods are 8 ft. 6 1/2 in., and 9 ft. 0 in. long between centres respectively. The latter are fluted and the former of plain rectangular section. The coupling rods are also of a plain section and these and the connecting rods are of high manganese molybdenum steel to the following analysis :

Carbon	About 0.25
Manganese	About 1.6
Sulphur	Below 0.04
Phosphorus	Below 0.04
Molybdenum	About 0.25

Some particulars of the heat-treatment used for these rods will doubtless be of interest. Blooms over 4 inches diameter or 4 inches square were reduced to one of these sections for testing and were heat-treated in this dimension as follows: Oil hardened at about 850° C. and tempered at 600/650° C., the test-piece was then required to give the following results :

Tensile . . .	40/45 tons per sq. inch.
Yield	Not below 30 tons per sq. inch.
Elongation . .	Not less than 22 %.
Izod.	Not less than 60 ft./lb.

The big ends for the outside rods have solid bushes pressed into the butt ends of the rods with white metal lining. The big ends for the inside rods are of the fork type with a glut and cotter fixing, the cotter being driven home without any allowance for draw, and particular care was taken that no draw be allowed on the split brasses. This is a departure from the strap type common to L.M.S. standard practice. The coupling and connecting rods have been provided with bronze lubricating rings, so that side wear on these parts will be reduced to a minimum, and special attention has been given to the lubrication of the motion parts in view of the long through runs that this type of locomotive will be called on to perform.

The piston valves are 3 1/2 inches wide over the rings which are of the narrow type. Six rings, 1/4 inch wide by 5/16 inch deep, are provided in each piston valve head. It may be remarked that the general adoption of this type of narrow piston-valve ring has given excellent results, the wear having been considerably reduced on the rings themselves, and also the liners, which obviously reflects itself in a more economical steam consumption, particularly when the engine is getting into a rundown condition. The fixing of the piston rod into the crosshead is by means of a cotter, and when driven home, the rod bottoms into the tapered socket of the crosshead, the taper of the rod end

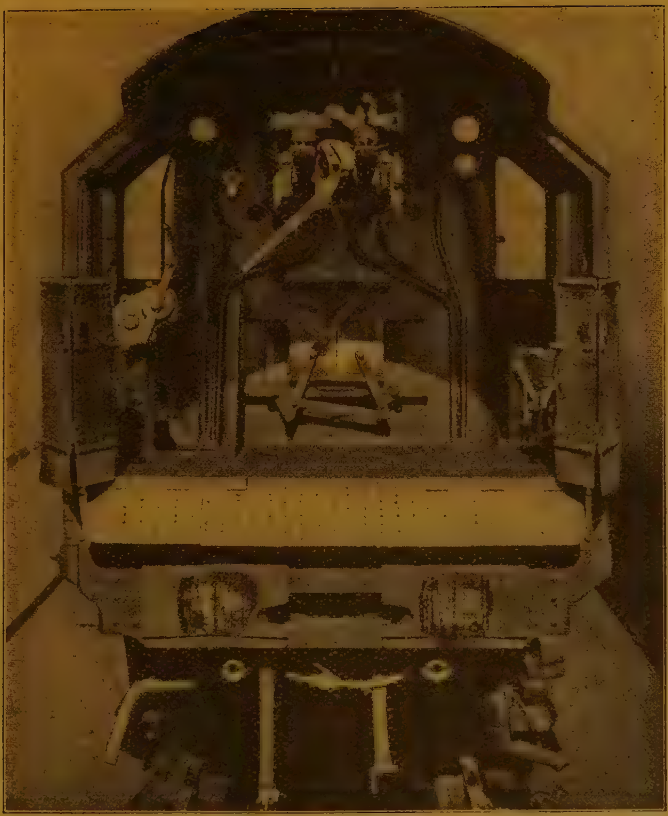


Fig. 3. — View of footplate and cab.

and socket being 1 in 18 and requiring a load of 30 tons to assemble. The taper on the cotter is 1 in 48. By this means it has been possible to restrict the clearance between the ends of the piston heads and cylinder covers to 1/4 inch, and this is of great value in keeping down the cylinder clearance volume. The piston rod is screwed 3 1/4 inches diameter, six threads per inch and tapered. The piston head is screwed out with a similar taper, but with an allowance so that when it is finally screwed home on the piston rod it requires a predetermined load to assemble.

The piston heads are of the box type, with plain end surfaces and three rings 5/16 inch wide by 9/16 inch deep are fitted. Air valves are fitted to each of the cylinders. This is in accordance with the standard practice, so that, when coasting, the vacuum created in the cylinders will lift the valves off the seats and allow air to pass into the steam chest, which mixes with the gases drawn from the smokebox, thus reducing the temperature of these gases and prevent-

ing the burning of the oil on the cylinder walls, pistons and valves. This avoids one of the great troubles of superheated engines, namely the accumulation of carbonised oil. The provision of efficiently atomised lubrication, already described, is also of great assistance in the prevention of carbonisation.

A separate Walschaerts gear is provided for each piston valve. This will ensure a correct steam distribution to each cylinder by avoiding any inequalities that are inevitable when one piston valve is controlled by means of a lever from the outside motion or *vice versa.* The valve events of the outside motion arrangement cover also the particulars for the inside motion. The vacuum pump is driven from the left-hand outside crosshead, the pump being carried at the front end of the bottom slide bar.

The arrangement of the reversing gear is such that the main reversing shaft which controls the outside motion is coupled through to the reversing screw in the cab by means of a two-throw lever carried in a plummer block. Advantage is taken here to provide the necessary effect for the reversing rod to clear the wide firebox. The connection from the main reversing shaft to the inside motion is by means of a connecting rod coupling through suitable levers arranged inside the main frames. The counterbalance arrangement for the motion is of the spring type. The spring gear is provided on the main reversing shaft on the centre line of the engine between the frames. Due to the great width of the firebox, it was necessary to offset the reversing rod between the intermediate reducing lever and the reversing screw bracket in the cab, and to obtain the necessary clearance for the reversing screw handle and the cab side, gear wheels are introduced. A similar arrangement to this, however, has been in use for some time on the L.M.S. Beyer Garratt engines.

The outside slide bars which are extended at the open end to couple on to the motion plate are of an inverted tee section and as near as possible to the outer position of the crosshead, and clips are fitted between the top and bottom bars. The slide bars attached at the cylinder covers are registered into the covers and a two-bolt fixing is provided at each end of the bars. Each crosshead is a steel casting with gummetal strips provided on the top and bottom bearing surface, so that in the event of heating and the white metal running, there will be no fear of the slide bars being scored due to contact with the steel faces of the crosshead. The gudgeon pin has a cast-iron split-ring washer provided on the outer end with the usual nut and cotter fixing. The standard type of cast-iron packing is used for each of the piston rods and is supplied with mechanical lubrication. The leading crank axle is of the built-up type, the portions for the axlebox bearings, big end journals and middle being of steel, with a carbon content of 0.3 to 0.35 per cent. The sweeps are of steel, having a carbon content of 0.4 to 0.45 per cent.

The diameter of the coupled wheels on tread is 6 ft. 6 in. This is rather smaller than those of the Royal Scot engines, which are 6 ft. 9 in., but as a means of obtaining maximum power and yet retaining a free running engine the 6 ft. 6 in. size was considered a very desirable dimension. The coupled wheel centres are steel castings and the same pattern is used for each of the coupled wheels. The rim is of a triangular section, which gives a pleasing appearance, and is at the same time of ample strength. The width of the coupled wheel tyres is a departure compared with the usual practice, the old dimension of 5 1/2 inches having been increased to 5 3/4 inches. The balance weights are built into the wheels as required, two steel plates being riveted together. The spokes act as distance

pieces and the necessary balance weight is added after the usual tests are made in the spinning machine, molten lead to the required amount being poured in between the plates. This section of wheel centre rim is used on all the engine and tender wheels and the Gibson type of tyre fixing with a retaining ring is adopted. The steel used for the coupled wheel tyres is of the best open-hearth acid quality with a maximum sulphur and phosphorus content of 0.040 per cent, tensile strength 50 to 55 tons per sq. inch, and a minimum elongation of 18 to 15 per cent. That used for the bogie and tender tyres is of the best open-hearth acid quality with a maximum sulphur and phosphorus content of 0.040 per cent and tensile strength 56 to 62 tons, with a minimum elongation of 13 to 11 per cent respectively.

Frames and spring gear.

The distance between the main frames of the engine is 4 ft. 1 1/4 in. and the thickness of the frames 1 1/4 inches, and advantage has been taken of this extra thickness to omit the usual type of horizontal frame cross stretchers which have been a feature on previous L.M.S. standard locomotives, it being considered that overstaying of the frames laterally is likely to interfere with their flexibility. In addition to the vertical stretchers that are provided on the intermediate and trailing coupled wheel axlebox guides, cross stays have been provided to prevent the frames coming in at the bottom, a common trouble when such large boilers are placed in position. Two separate hind end frame plates are provided at each side, and spliced to the main frame, the outer hind frames being splayed outwards and carried through to the hind buffer beam; these are 1 inch thick. The inner frames, 1 1/4 inches thick, are set slightly inwards to take the centre casting for the trailing two-wheeled truck, and these are also carried through to the hind

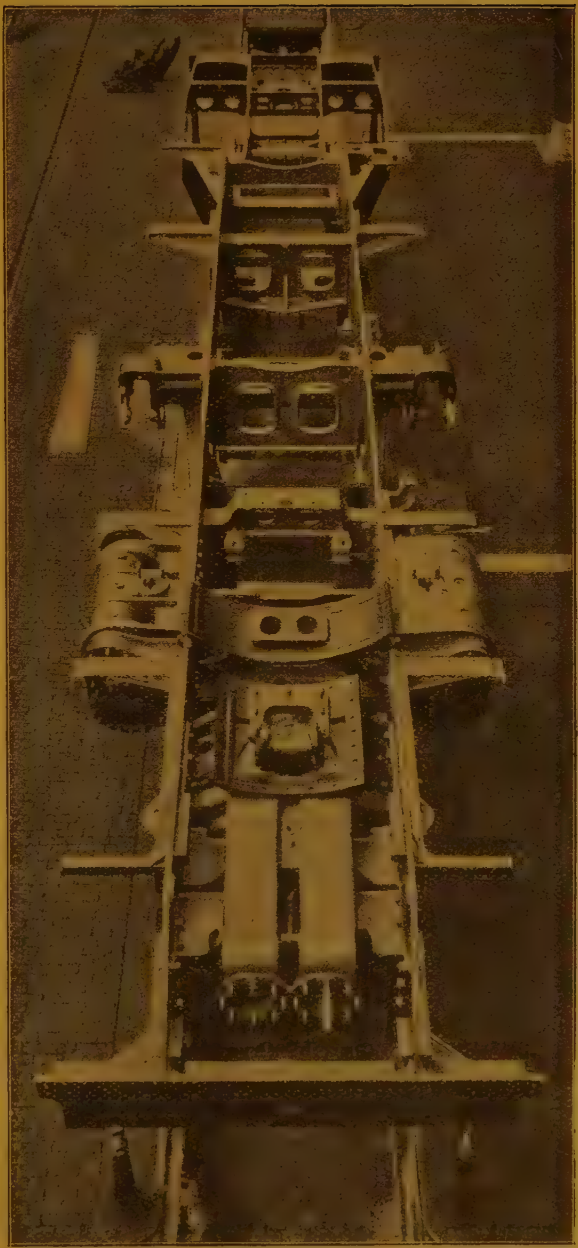


Fig. 4. — Frames and cylinders from front end.

buffer beam and the main centre drag box casting.

Owing to the limitations to the depth of frames just below the throat plate of the firebox, it required careful scheming to provide the necessary strength to resist the heavy stresses imposed when lifting the completed engine. All the rivets at the main frame joint are a turned driving fit and riveted cold, and, in addition, the joint is welded at all the outside edges. The carrying of the boiler at the front end of the frames is effected just behind the smokebox tube plate, and the second support is between the intermediate and trailing coupled wheels. Here a gunmetal bearing strip is provided between the bearer and frame support for the necessary movement due to expansion, and, in addition, clips are provided at the side. At the front end of the firebox, the foundation ring is utilised as another sliding support, and on the bottom face of the foundation ring a gunmetal bearing strip is fixed. At the hind end of the firebox, the foundation ring is carried below the plate joints, and a 1/2 inch thick diaphragm plate in approximately a vertical plane is rigidly attached to this projection, and the bottom edge of the plate is fixed to the steel casting which forms the drag-box. This completes the carrying arrangement for the boiler.

The coupled wheels are fitted with laminated springs of a ribbed section, the material being silico-manganese steel to the following analysis :

Carbon	0.5 to 0 6 %.
Silicon.	1.8 to 2.0 %.
Sulphur	0.04 %.
Phosphorus	0.04 %.
Manganese	0.7 to 1.0 %.

The treatment for 1/2-inch and 5/8-inch plates is as follows :

Plates heated to approximately 850° C. and bent to the required camber and cooled below 600° C.; reheated to 890° — 900° C. and quenched in linseed oil; tempered in a furnace standing at 800° C. for four minutes for 5/8-inch plates, 3 1/3 minutes for 1/2-inch plates or until on trial with a hazel stick a heavy smoke and no sparks are produced or until the temperature of the surface of the plate measured with a contact pyrometer is 400° to 425° C.

Screwed adjusting spring links are provided, the material for the spring links being of a high manganese steel to the following analysis :

Carbon	0.15 to 0.2.
Silicon	Not more than 0.25.
Sulphur and phosphorus .	Below 0.04.
Manganese	1.5 to 1.7.
Nickel	0.3 to 0.5.
Molybdenum	0.2 to 0.3.

This material in bar form was oil-treated and tempered at 600° to 650° C., and gave the following test data :

Tensile.	40 to 45 tons per sq. in.
Yield	75 % of breaking stress.
Elongation	20 to 25 %.
Izod	Not less than 70 ft./lb.

The screwed ends of the spring links have a knuckle thread, and, to provide for the necessary movement at the ends of the springs, the links pass through a shoe, which is provided with a gunmetal seating and a spherical washer of steel, the surfaces of which are ground. The material used for the spring links was also used for the special bolts fitted through the leading crank pins for retaining the crank-pin washers. Damper springs consisting of alternate layers of thin steel plate and rubber are provided between the spring link heads and the frame brackets.

A steam brake operates at the front of each of the coupled wheels. The total weight on the rails ranking for adhesion is 67 1/2 tons, and the brake proportion of this weight is 74 per cent, or expressed as a percentage of the whole engine, 47.8 per cent.

Coupled wheel axleboxes.

The coupled axlebox journals are as follows : —Leading, intermediate and trailing, 10 inches diameter by 10 inches long. No collars are provided on the intermediate and trailing axles. The axleboxes are of robust design, being steel castings, and provided with pressed-in brasses and the usual white metal crowns. Lubrication to the axleboxes is supplied from the 10-feed mechanical lubricator fitted on the right-hand side of the engine. The lubricant is fed to the crown of each axlebox where a back-pressure valve is provided. A length of special rubber oil hose couples this back-pressure valve to the pipe-line bracket on the frame, thus allowing complete freedom to the axlebox movement. The oil supply is controlled by gear driven from the outside expansion links which gives a constant travel for all positions of the valve motion, the minimum oil feed being 2 ounces per 100 miles per axlebox, this in the past having given quite satisfactory results on all classes of locomotives on the L.M.S.R. It should be noted, however, that by altering the position of the driving links, the oil supply can be increased if necessary.

In addition to the top feed lubrication, the axlebox underkeeps have been provided with ample depth, and a substantial oil pad built on a light frame and carried on a centre coil spring is fitted. the pad being made of a mixture of horsehair and wool and supplied with worsted feeders which feed the pad from the oil reservoir.

The intermediate drawgear between the engine and tender is controlled by a laminated spring housed in the tender dragbox. The spring has an initial load of six tons. The main drawbar is directly connected to the spring buckle, and at the engine end the main drawbar pin has only a clearance in the drawbar hole of 1/16 inch in diameter. The side buffing spindles have specially designed heads which ride on inclined planes (case-hardened) riveted to the hind engine buffer beam. The object of this gear is to obtain smooth riding between the engine and tender.

The wheelbase of the leading bogie is 7 ft. 6 in. and the diameter of the wheels 3 feet. Bar frames are provided and a centre cross-casting in which engages the engine bogie pin, also provides the slides. The maximum lateral movement allowed on the bogie centre is 2 7/8 inches each way, *i.e.*, a total of 5 3/4 inches, and a stop on the engine main frames limits the swivelling movement of the bogie, this being essential to maintain the necessary clearance of the bogie wheel tyres and the inside cylinders. The springs for the bogie bearings are of the inverted laminated type with screw adjustements, the material being similar to the springs for the coupled wheels. The journals have a bearing of 6 1/2 inches diameter by 11 inches long. The axleboxes are solid gunmetal with a white metal crown, a sliding underkeep and a similar type of oil pad to those in the coupled wheels is used, but only underkeep lubrication is provided.

Side bolsters transmit the load from the main frames to the bogie. Suitable lubrication is provided both for the bolster and cup sliding face. The side check spring arrangement is of a very flexible type, the initial load being 2 tons, and with the bogie right over the centring load is 3 tons.

It was decided that the trailing two-wheeled truck should be of the Bissel type, and the bogie arm is anchored at a point 6 ft. 10 in. in front of the axle centre to the engine cross-stretcher casting immediately in front of the firebox throat plate. The diameter of the wheels is 3 ft. 9 in. on the tread. The transmission of the weight from the main frames to the bogie is, in this case, also, by means of side bolsters, but due to

the limitation of the design, these are placed inside the bogie wheels. The outside axleboxes are of solid gunmetal with white metal crown, the laminated springs being carried above the boxes. Adjustable screwed links are provided with rubber damper springs. The journals are 7 1/2 inches by 12 inches long. The lubrication to these boxes is of the underfeed type, the oil pad being similar to those in the four bogie wheels. The axleboxes being of the outside type, a cover plate provides facilities for the examination of the underfeed oil pads. The lateral movement allowed for on the truck is 4 1/4 inches each way, *i. e.*, a total of 8 1/2 inches, and again in this case, a very flexible bogie side check spring arrangement is provided, the initial load being 1.44 tons, with a maximum centring force of 2.96 tons. The spring gear, bogies, balancing and intermediate drawgear, etc., have been carefully considered with regard to the smooth riding of the locomotive and tender as a whole.

The particulars of the hammer blow, calculated at 5 revolutions per second, are as follow :

Each pair of coupled wheels . . .	0.14 tons.
Total hammer blow for engine . .	0.42 tons.

The revolving weights in the crank axle, due to the big end journals, are balanced by the sweeps being extended at the opposite end.

Boiler and firebox.

The boiler barrel tapers from 6 ft. 3 in. diameter at the throat plate to 5 ft. 9 in. diameter at the smokebox tube plate. The latter is of the drumhead type. The distance between the tube plates is 20 ft. 9 in., and the following tubes are provided :

16 steel superheater tubes, 5 1/8 inches diameter, 7 S. W. G.

170 steel boiler tubes, 24 1/4 inches outside diameter, 11 S. W. G.

The flue tubes are of steel, the ends at the firebox tube plate being specially thickened up and screwed 11 threads per inch. After expanding in position they are beaded over. All the small boiler tubes are beaded over, and for both superheater and boiler tubes six-roller expanders were used, providing a slight taper in the tube end, the larger diameter being on the water side of the tube plate. The pitching of the boiler tubes allows for a diagonal bridge of 7/8 inch and a vertical bridge of 1 1/8 inches, and between the tubes and the boiler barrel ample water space was allowed as a means of providing efficient water circulation. Each of the longitudinal joints in the boiler ring was welded for a distance of 1 ft. 0 in. The bottom corners at the foundation ring joints were also welded, and all pads on the doorplate and boiler barrel for mountings were welded after riveting. The smokebox tubeplate and firebox doorplate are stayed with the standard type of longitudinal stays.

The firebox has a grate area of 45 sq. feet, with the object of affording a low rate of combustion, and also to ensure that, when making long through runs, the firebars will not be unduly clinkered, and so prevent satisfactory combustion. The firebox at the front end is 7 ft. 1 in. outside at the foundation ring, but at the doorplate 6 ft. 1 in., this being specially arranged to facilitate satisfactory hand firing in the back corners. The provision of a large oval firehole, 1 ft. 7 in. long by 1 ft. 2 in. deep, also helps in this direction. The width of the foundation ring is 3 3/4 inches and the waterlegs gradually widen to 5 1/2 inches at the top of the firebox, this, again, to facilitate water circulation. The dimension between the copper crown plate of the firebox and the steel wrapper plate is 2 ft. 0 in., to provide ample steam space above the water level. The provision and position of mud plugs and mud doors has received careful

attention from the point of view of thoroughly washing out the boiler and firebox.

In the construction of the firebox copper stays 7/8 inches diameter, 11 threads per inch, are provided on the two outer side rows and on the six top rows, and the same applies on the doorplate except that only the top three rows are copper. The other stays are of mild steel, 5/8 inch diameter, 11 threads per inch to the following specifications :

Tensile strength 28 to 32 tons per sq. inch with an elongation of not less than 28 % on 2 inches (British standard test piece « C »).

The copper stays are riveted over, both on the outside of the steel plate and on the inside of the copper pieces, but for the steel stays a nut is fitted on the inside of the copper plate, the end of the stay finishing just inside the face of the nut. They are caulked only on the outside of the steel plate. Alloy stays of 80 per cent copper and 20 per cent nickel have been used at the throat plate. This material concerns the stays only in the curved portions of the throat plate and the two outside rows. The remaining stays on the flat portion of the throat plate are of mild steel.

Boiler mountings.

The safety valves, water-gauge frames and protectors and other similar fittings are of the railway company's standard type, but some of the details are of interest, as they are a distinct departure from L.M.S. practice. Four Ross pop type valves 2 1/2 inches diameter, set at 250 lb. pressure and the same type as are used on the Royal Scot engines are fitted. As previously stated, 16 superheater flue tubes have been provided. This, of course, results in a considerably increased ratio of evaporative heating surface compared with the standard type of L.M.S. boiler, but, at the same time, the steam should be sufficiently superheated to meet all requirements. The superheater elements are provided with spherical ball joints, and the elements are 1 3/8 inches outside diameter by 11 S.W.G. thick.

The main steam pipe is of the steam collector and drier type, the inlet being at the highest point of the firebox above the tube plate, the steam thence passing along the top of the boiler to the combination regulator and superheater header. The regulator is also a departure from L.M.S. practice, being incorporated inside the smokebox with the superheater header casting. The control for the regulator is of the usual type at the firebox doorplate, and a small sight feed lubricator is provided in the cab so that the driver can control the feed (about 1 drop of cylinder oil per five minutes) to the regulator to ensure easy operation, and as an additional means to this end, a balance weight is also provided on the regulator handle. A distinct change from L.M.S. practice has been the provision of a steam manifold on the top of the firebox doorplate. The main steam supply can be shut off as required. Steam control valves are provided for the following : injectors, ejector, steam brake for engine and tender, carriage warming, pressure gauge, ashpan flush injector, sight feed lubricator to regulator and whistle. The whistle has been placed in a horizontal position in order to come within the overall height above the rail, and is of the old Caledonian Railway type, well known for its melodious note.

The blower is fitted on the firebox doorplate on a separate pad below the main regulator, and is placed in a convenient position for the enginemen. The injector on the fireman's side is a Davies & Metcalfe exhaust steam injector with 12-mm. cones, and on the driver's side a Gresham & Craven live steam injector with 13-mm. cones is fitted. The injectors deliver through top feed clack

valves. Sliding trays of the usual type are fitted underneath the water delivery nozzles inside the boiler to permit periodic cleaning as and when necessary.

An outstanding feature on existing standard L.M.S. locomotives is the Dreadnought type of ejector which is carried at the front end of the boiler on the left-hand side. A departure is made on this 4-6-2 engine in that the ejector is fitted on the left-hand side of the firebox just immediately in front of the front cab plate. The Gresham & Craven driver's brake valve is also of a modified design, this having three positions, viz : « running, » « brake on » and « ejector on. » The provision of the vacuum pump operated from the left-hand crosshead calls for use of the ejector only when standing or running at low speeds.

The boiler, firebox and cylinders are covered with plastic magnesia, this being applied while the boiler is hot. The outer clothing plates are of sheet steel 14 W. G., and the usual belt fastenings are provided at the joints of the clothing sheets. The fire grate is built up of two rows of cast-iron firebars of the standard pattern, the front firebars being slightly sloped and the hind firebars level, the proportion of air space through the bars to the total grate area being 40.2 per cent. Owing to the position of the trailing two-wheeled truck under the firebox, the ashpan had to be arranged to accommodate this, but by the provision of front, middle and hind damper doors a percentage of 17.22 of air to the grate is provided, and, in addition, side damper doors between the bottom of the foundation ring and the top of the ashpan sides provide a further 9.43 per cent, making in all a total of 26.65 per cent. It was considered very desirable to provide these top side ashpan dampers, so that sufficient primary air would be available at the sides of the wide firebox where the bottom of the ashpan is very close to the firebars.

The three main ashpan dampers (front, middle and hind) have separate control handles provided in the cab, and an additional handle is provided to control the side ashpan dampers. To facilitate cleaning out the ashpan, a flushing pipe is fitted on the inside, the water supply being taken from the injector feed pipe to the right-hand injector by means of a small Gresham & Craven vertical type injector controlled from the cab.

Smokebox and chimney.

The diameter of the smokebox is 6 ft. 1 in. inside and the wrapper plate 1/2 inch thick. This is carried at the front end on a saddle which is an extension on the inside cylinders. At about the centre of the smokebox the exhaust branch pipe steel casting connects each of the outside cylinders and is also combined with a saddle to carry the smokebox. On each side of the smokebox a steam pipe leads from the header to a tee piece from which branch pipes are led to the inside and outside cylinder. The steel steam pipes are provided with cone joints. The exhaust passages from the inside and outside cylinders to the blast pipe have been arranged to avoid any abrupt change of direction, and also to provide a gradually diminishing area before arriving at the blast pipe cap. The latter is provided with a jumper ring, which, when the engine is working under heavy conditions, will lift due to the increased back pressure, and thus an enlarged blast pipe orifice will automatically reduce the back pressure and be a means of reduced coal consumption. The smokebox door fixing is of the dart and centre bar type, the door joint being a bevelled face.

The chimney bore is tapered from the throat to the top, the diameter at the throat being 1 ft. 4 1/4 in. A baffle plate is provided across the smokebox; this is to equalise the draught over the

boiler tubes, but this plate can be removed if necessary to facilitate cleaning the boiler tubes. The exhaust from the ejector is coupled up to a silencer which consists of a circular casting provided at the throat of the chimney and combined with this casting is a blower ring. The exhaust steam supply for the exhaust injector is taken from the base of the blast pipe in the usual way.

Footplate details.

A great deal of thought has been given to the cab arrangement, and it was decided to make a wooden model in the shops so that the various controls could be tried out before the positions were finally decided. Needless to say, this proved a very great help. The overall width of the cab is 8 ft. 10 in. outside, which provides a very roomy interior.

Double sliding windows are fitted on both sides and on the driver's side on the outside of the cab and between the sliding windows a small glass screen can be turned into position so that when the engineman is looking outside the cab it acts as a draught preventer for his eyes. A hinged window giving ample area for lookout is fitted on each side in the cab front plate. In the cab front plate at the top a number of 1/2-inch holes are provided so that a current of air will pass along the inside of the roof and a sliding ventilator in the cab roof itself should ensure comfort in this direction. Tip-up seats are fixed on both sides of the cab, and to prevent exposure to cold crosswinds, gangway doors, spring controlled, are fitted between the engine cab and tender panel plate; rubber extensions are attached at the bottom of the gangway doors.

Mechanical sanding is provided and the sandboxes are fabricated from steel plate and are provided with suitable extensions where necessary so that the filling of the sandboxes is made as easy as possible for the enginemen. The points sanded are in front of the leading and in front and behind the intermediate coupled wheels. In conjunction with the leading sandgear a water desanding valve is fitted on the left-hand side of the firebox. This is coupled to the sanding lever so that when the leading sand is operated a hot water jet is directed to the rails which cleans the sand away after the coupled wheels have passed over, this with the object of preventing interference with track circuiting.

The standard type of carriage warming is fitted through from the locomotive to the hind end of the tender, the working pressure being set at 50 lb. per sq. inch. Various points on the locomotive have been fitted with grease lubrication, *i.e.*, the Bissel truck anchor pin, top and bottom brake hanger pins on engine and tender, reversing lever pins and reversing gear in cab and the intermediate side buffer heads.

Tender.

The tender is of conventional design with the exception that the water capacity is increased to 4 000 gallons, and the coal capacity to 9 tons. It will be noticed that the only access into the cab is by means of the tender front foot-steps. This is due to the large throw-over of the engine cab end not allowing sufficient clearance at station platforms. The standard type of water pickup apparatus is provided, but because of the large lateral movement at the engine cab end when taking curves, the vertical type of pillar control handles for both the water pickup gear and tender hand brake was discarded. The gear is built into pockets at the front of the tender tank and the handles are arranged to work in a vertical plane; bevel gear is employed to couple through to the water pickup and hand brake shafts in the usual way. The usual type

of water feed valve and control is provided.

A steam brake is provided on each of the six tender wheels, and is applied simultaneously with the steam brake on the engine. The brake blocks are fitted behind each wheel. The brake percentage, on the basis of the tender being two-thirds loaded with coal and water, is 60 per cent. Timken roller bearings are fitted on all the tender wheels. An oilbath in the bottom of the housing for the roller bearings is provided which should only require occasional attention for filling up with oil. The wheelbase of the tender is 15 ft. 0 in. and the wheels are of standard diameter, 4 ft. 3 in. on tread. The overall length of the wheelbase of the engine and tender is 63 ft. 10 in.

Chief dimensions of locomotive.

The following are the principal dimensions of the locomotive :

Cylinders (4) diameter	16 1/4 inches.
— stroke	28 inches.
Wheels, coupled, diameter	6 ft. 6 in.
— leading bogie	3 ft. 0 in.
— trailing bissel	3 ft. 9 in.
Wheelbase, coupled	15 ft. 3 in.
— total, engine	37 ft. 9 in.
Boiler pressure.	250 lb. per sq. inch.
Boiler, length of barrel	20 ft. 7 5/16 in.
— diameter outside at front	5 ft. 9 in.
— — at firebox end	6 ft. 4 3/4 in.
— firebox, outside	8 ft. 6 in. by 7 ft. 1 in. and 6 ft. 1 in.
— — inside	7 ft 7 3/4 in. by 6 ft. 1 in. and 5 ft. 2 in.
Heating surface, large tubes (16), outside diameter 5 1/8 inches; small tubes (170), outside diameter 2 1/4 inches; length between tube plates, 20 ft. 9 in.	2 523 sq. feet.
Firebox.	190 —
Total . . .	2 713 —
Superheater	370 —
Combined total. . .	3 083 —
Grate area	45 —
Tractive effort at 85 % of the boiler pressure.	40 300 lb.

[621.132.3 (.43)]

4-6-2 type four-cylinder compound express locomotives for the German State Railways.

(*Engineering.*)

It is well known that the German State Railways have been experimenting in recent years with various special types of locomotives, several of which have been described at one time and another in these columns. Such special locomotives have included turbine and high-pressure machines, Diesel locomotives, etc., in addition to which the Administration produced standard steam types which brought about very appreciable economies in fuel and upkeep. It has recently been considered desirable to attempt to carry the matter further, and to ascertain what additional economy is to be derived from the ordinary type of steam locomotive by the use of higher temperatures and pressures.

The German State Railways have already had experience with a boiler pressure of 22 atmospheres (323.4 lb. per square inch) and it was decided to construct two machines with boilers pressed up to 25 atmospheres (367.5 lb. per square inch), employing for the purpose alloy steels of high heat-resisting qualities. Such materials have now been employed for the first time on these railways, in the construction of two 4-6-2 type four-cylinder compound locomotives of the 04 class of the State Railways. These engines, shown in the illustration, are designed for express work and have been constructed by Messrs. Fried. Krupp A.-G., of Essen. Under the circumstances the chief interest centres in the boilers. In one case the plates and stays were made of a chromium-molybdenum steel, and in the other of a copper-manganese steel. The physical characteristics of the two are much the same, as shown by the figures below, but whereas the chromium-molybdenum steel is more expensive, the copper-manganese alloy is little more so than the quality of the material usually employed in such boiler work.

	Chromium-molybdenum steel.	Copper-manganese steel.
Tensile strength	52 kg. per mm^2 (33 Engl. tons per sq. in)	52 kg. per mm^2 (33 Engl. tons per sq. in.).
Yield point at 225° C.	36 kg. per mm^2 (22.9 Engl. tons per sq. in.)	29 kg. per mm^2 (18.4 Engl. tons per sq. in.).
Elongation at 20° C.	20 %.	22 %.

The fireboxes in both cases are of Krupp's Izett I steel, which is specially resistant to ageing, the staybolts, as stated, in each case being of the same material as the boiler plates. With a view to determining the best superheater proportions, the two boilers are fitted with superheaters of different dimensions. The chromium-molybdenum steel boiler has superheater elements of large size and 6 800 mm. (22 ft. 4 in.) long, whereas in the other boiler a standard type

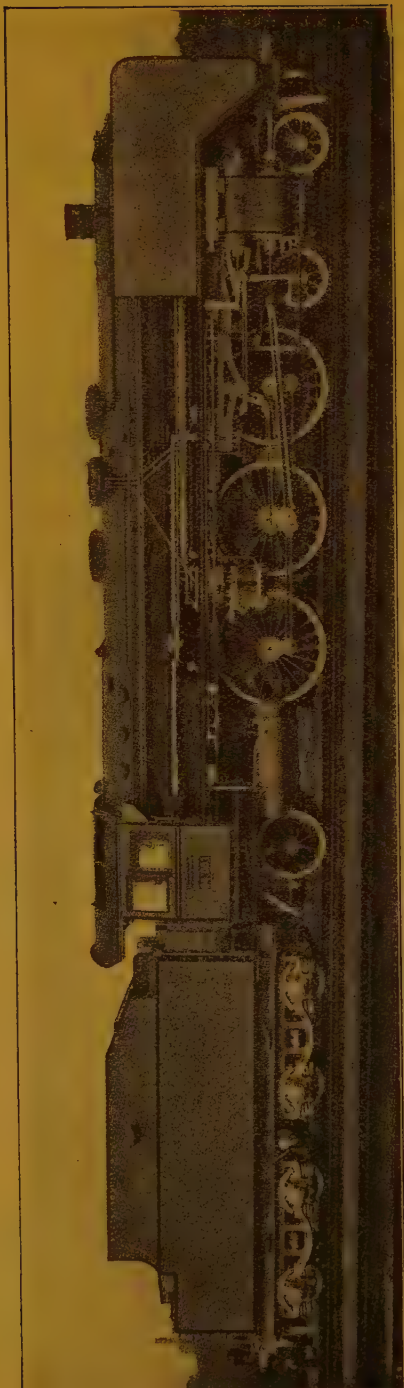


Fig. 1.

superheater is employed with elements 5 800 mm. (19 feet) long. In other respects the locomotives are identical.

The high-pressure cylinders (13 3/4 in. × 26 in.) are of cast steel with cast-iron liners. Between the frames they drive on to the leading coupled axle. The low-pressure (20 1/2 in. × 26 in.) are of cast iron, and drive on to the middle coupled axle. The right-hand high-pressure crank is opposite the right-hand low-pressure crank; the left-hand cranks are arranged in like manner. Steam distribution for the high-pressure cylinders is by piston valves of the standard German State Railways pattern; for the low-pressure cylinders, double-ported piston valves are employed, with outside admission. These valves are driven direct by Heusinger (Walschaerts) valve gear, the high-pressure valve motion being taken from this gear by rocking shafts. One gear in the cab controls both high- and low-pressure valves. The maximum cut-off possible, both forward and reverse, is about 80 %. By-pass valves are fitted to both high and low-pressure cylinders, operated by compressed air from the cab.

With boiler tubes 6.80 m. (22 ft. 4 in.) long, the tube heating surface is 186.8 m² (2 011 sq. ft.). The firebox heating surface is 20 m² (215.28 sq. ft.), and the grate area 4.1 m² (44.1 sq. ft.). The engine, which has a wheel base of 12 m. (39 ft. 4 1/2 in.), weighs, light, 100.7 tons (metric), and 109.5 tons in working order.

The coupled wheels are 2 m. (6 ft. 6 3/4 in.) in diameter. The tender has a capacity of 32 m³ (7 043 gallons) and will take 10 tons of coal. The wheel base of the tender is 5.70 m. (18 ft. 8 1/2 in.).

The locomotives have been subjected to a number of trials, and show a saving of steam of 20 % compared with the standard four-cylinder compounds of similar size. Continuous runs at 120 km. (74.56 miles) per hour were made for the first time in Germany.

[621. 392 (.42) & 625. 15 (.42)]

Repairing crossings by welding on the Southern Railway (Gr. Bn.).

(*The Railway Engineer.*)

The necessity for economy, together with the increased wear of rails — particularly at points and crossings — due to the progressive extension of electric traction and the consequently greater and faster train service on the suburban lines of the Southern Railway, stimulated the investigation of new methods of maintenance. This led to experiments being made in building up worn parts of crossings by electric welding. When it is realised that in many crossing replacements a length of about 16 yards of serviceable rail is scrapped for the sake of a few inches of heavy localised wear, the possibilities of economy by welding can be understood.

Success has gradually been achieved, and welding worn crossings is now standard practice on the Southern Railway. Up to the end of 1932 the numbers of crossings welded on the London East Division — comprising some 550 route-miles of line, most of which are electrified (2) were : 1 302 once welded, 250 twice welded, 96 thrice welded, 27 four times welded, 4 five times welded.

The average time taken to weld a crossing is 2.7 hours, and to shape up by grinding 1.85 hours, or 68 % of the welding time. The average number of electrodes used per crossing is 25 (*i.e.*, 23 No. 6 gauge and 2 No. 8 gauge). If a wing rail be very badly worn, it is changed rather than welded up, the replacement of a wing rail being a comparatively simple and inexpensive procedure.

The process of welding.

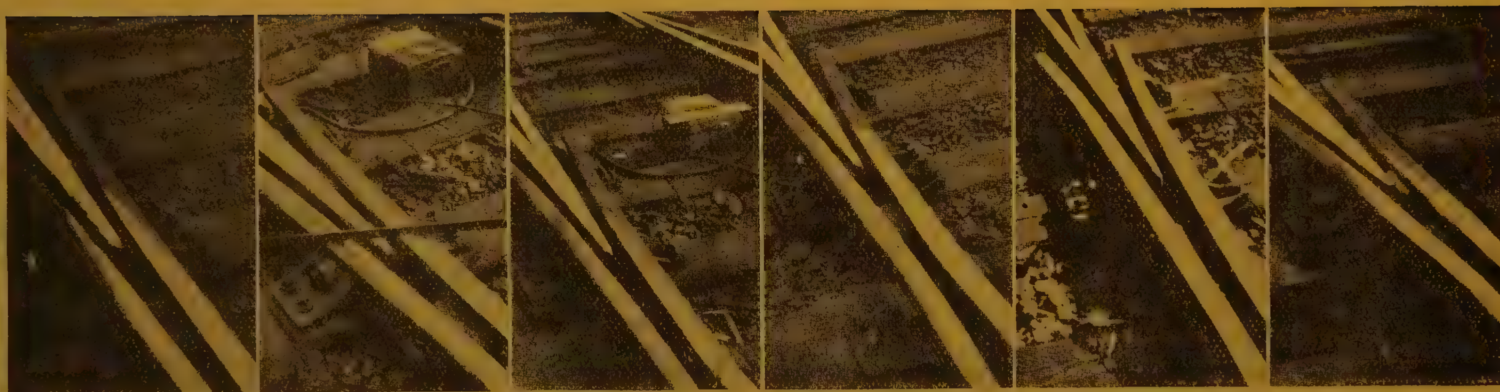
Before the welding of a crossing is begun, it should be put into sound fettle by tightening, or renewing if necessary, all crossing bolts and chair fastenings. Any movement of the crossing under load should be stopped by the insertion of liners. The timbers should be in good condition and tightly packed up. It is important to see that gauge and flange clearances are correct.

The welder must first trim up the parts to be welded by chipping off burred edges and grinding, or both. Dirt and grease must be cleaned off. This is to ensure that the weld metal is deposited on sound and clean parent metal. Welding of the crossing is first begun by depositing a run of metal on the running edge of the wing rail, followed by runs on each edge of the nose, making a total of four runs. A run is next put down in the depression which the outer edge of worn wheel tyres causes in the wing rail. This makes a total of six runs. The welder then proceeds to fill in the areas so enclosed to the required depth, putting runs alternately from the back and running edge of the wing and each side of the nose. This has a double purpose, first by alternating between wing and nose, the run of weld metal is allowed to cool before the next is applied, thus avoiding excessive heating without waste of the welder's time; and secondly the nose and wing are kept relatively at the same height, thus ensuring smooth running of

(1) Abstract of a paper, by A. W. Sheldon, read before the Permanent Way Institution, in London, on the 12 April 1933.

(2) The extent of this Division has since been modified.

Fig. 1.



Before welding, showing ragged metal to be ground off. | After preliminary grinding, showing depth of wear to be built up. | First runs of weld metal put on. | Building up by welding, completed and ready for grinding. | Welded metal ground to correct level and gauge. | Welded crossing after two years under wear (5 trains an hour).

Fig. 2. — Welding in progress with petrol-electric portable plant, showing cradles for transporting sections.

Fig. 3. — Motor-generator portable welding plant for working off live rail.

traffic over the crossing and preventing damage to the weld metal by traffic while the work is in progress. Runs of weld metal on the noses should always be applied from the tip, while runs on the wing rail should be made towards the knuckle. The runs on the wing rails should not be finished on the square at the knuckle, but on the skew, so as to avoid shock to traffic. Subsequent layers of weld metal are put on in a similar manner.

The welding having been completed, it remains only for the welded portion to be ground off smooth and to correct surface alignment with the adjacent unwelded rail. At the same time the correct relative height between nose and wing rail, as well as flangeway clearance, is obtained by the use of a gauge or template with which each welder should be supplied.

There may seem to be nothing unusual about this procedure, but it is described in detail because experience has shown that extreme care in workmanship is essential if the welds are to stand up to hard service. In fact, workmanship, materials and plant must be as near perfection as possible.

Fig. 4. — Grinding welded crossing.

Good workmanship and good materials are closely related. The deposition of the weld metal should result in a dense homogeneous run, free from blow-holes, voids and slag inclusions, and proper penetration or fusion with the parent metal should be obtained. A section of a welded rail, sawn through and polished, will show whether these conditions are being fulfilled.

It is important that the welder should keep as short an arc as is possible, consistent with proper penetration and easy running of the electrode. By this means the heat is kept as low as possible and the risk of damage to the parent metal, as well as to the weld metal by oxidation, is avoided. Further, considerable loss of alloyed elements, such as manganese and carbon, may occur if the arc be long.

Careful attention should be given not only to obtaining proper fusion with the parent metal but also between each run of weld metal. To ensure this it is essential that the slag should be completely removed by chipping and brushing after each run. Longitudinally each run should overlap the previous run by half its width. By this means an even surface is obtained and the final grinding off is reduced to a minimum. It is wrong to put two runs of weld metal down so

that their edges just touch and then to fill in the hollow so formed between them with a third run, as, apart from the difficulty of even welding, there is an increased risk of voids and slag inclusions.

The order and direction in which the runs should be made, as described above, make it necessary for the welder, unless he is a contortionist, to be able to weld with either hand. To a man who has been accustomed to using only one hand this may appear to be very difficult, but quite a brief period of practice makes it surprisingly easy.

When the necessary weld metal has been deposited, the crossing should be so ground and smoothed off that when traffic passes over it there is no semblance of hammer to cause failure of the weld. To obtain this condition the relative levels of the nose and wing rails must be correct, and any time spent in assuring this is amply repaid. Of great assistance in guiding the welders in getting these levels correct is the template gauge.

Another important factor in ensuring a long life for a welded crossing is its careful maintenance by the permanent-way staff. It is absolutely essential that the crossing should be kept in good fettle after welding. The timbers should be well packed and chairs and screws all tight. Otherwise all the care taken in obtaining the correct relative levels of the nose and wings will be of no avail. The desirability of maintaining all crossings, welded or otherwise, in good fettle cannot be too strongly emphasised.

As to materials, the importance of suitable electrodes is vital. The composition of the electrode does not necessarily indicate what will be the composition of the deposited metal, for the proportions of essential elements contained in the former — manganese, carbon, and so on — may be very different after fusion and deposition due to losses in the arc. For this reason the analysis of the deposited metal is more important and informative to the permanent-way engineer than any description of the electrode.

Means have been devised by manufacturers of electrodes to overcome these losses, with varying degrees of success. Some manufacturers have incorporated elements other than those in the ordinary rail steel. The chief properties required in the weld metal are toughness to give resistance to wear, ductility, and a good fusibility with the parent metal. Each is apparently comparatively simple to achieve alone, or even two of them together, but to ensure all three is not simple. Nevertheless, satisfactory electrodes are available on the market and, given good workmanship, the results can be completely satisfactory.

Portable welding plant.

For permanent-way work portable welding plant is necessary and should be as simple as possible consistent with reliability under field conditions. Such plants are in use on the Southern Railway of two principal types, the motor generator, for use in electrified areas, deriving its power from the third rail, and the petrol-electric set.

The petrol-electric-power plant consists of three units :

1. a petrol engine of about 15-H.P. rating, directly coupled to

2. a dynamo of about 6-kw. capacity, and both are mounted on

3. a frame, from which each can be detached separately for transportation purposes.

The maximum weight of any one of the three parts should not exceed 6 cwt. Apart from portability, they should be capable of being totally covered in and locked up when not in use. In the design of such a plant, sufficient margin should be allowed in the rated output for the necessary power to overcome the inevitable losses of efficiency due to site conditions. Leads sometimes have to be as much as 100 yards long, and owing to

the use of the plant in outlying places it is not always possible to maintain mechanical efficiency at its maximum without undue expense. All-electric motor-generator-plants, similarly portable, of course obviate the necessity of attention to a petrol engine, and to that extent simplify the working. Taking current from the positive conductor rail, the voltage of which may vary very considerably, necessitates a specially-designed motor fitted with automatic controls to protect it when the voltage fluctuates beyond prescribed limits.

The apparatus for grinding the deposited metal smooth and to correct gauge and profile consists of a portable 2 1/2-H.P. 50-volt electric motor, which drives through a flexible shaft about 7 ft. 6 in. long and 8 inches diameter by 1 1/4-inches wide grinding wheel, at a speed of nearly 3 000 r. p. m. Its motive power is derived from the welding generator, and on completion of the welding it is attached to the welding cables.

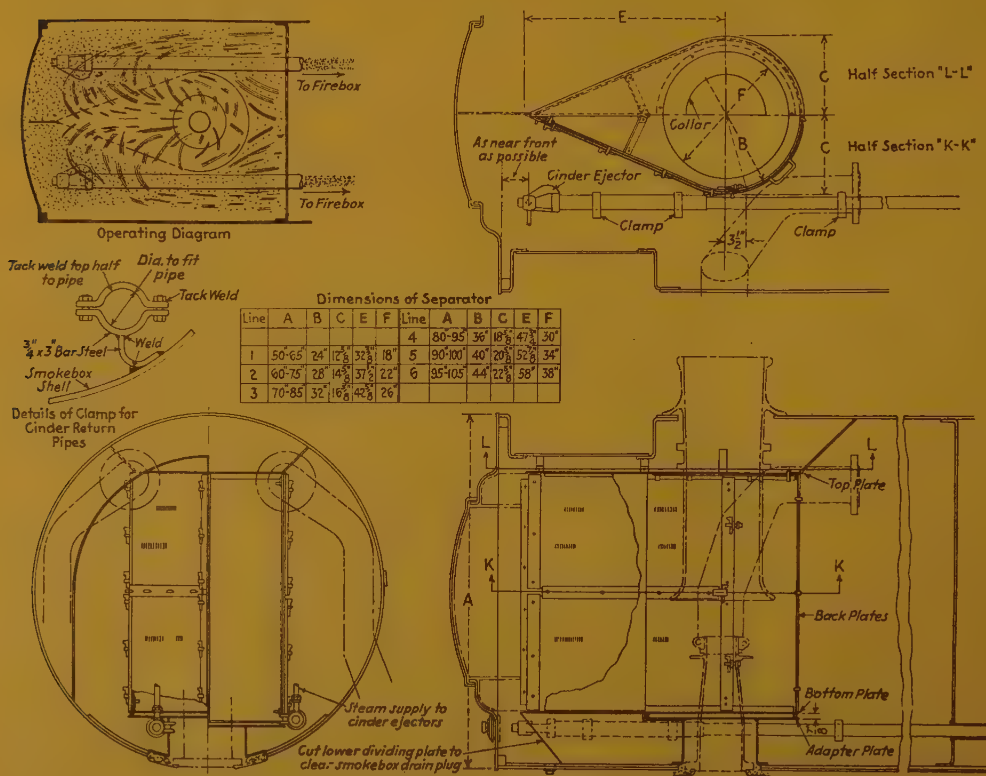
The whole of the work — unless there is a wing rail to be changed, and this is a matter of a few minutes only — is carried out without interruption of the traffic or blocking the line and thus the process is eminently suitable for crossing maintenance in areas of intense traffic. The economies resulting from this method of crossing maintenance arise not merely from the rapidity with which the work can be done and the saving in actual material, but also from the saving in labour and interruption of traffic necessary when whole crossings are renewed. Especially is this so in areas where there is track circuiting, and the replacement of rails necessitates the breaking and re-making of bonded joints. Another economy difficult to assess arises from the possibility of the more frequent repair to crossings which can be made at low cost, thus avoiding the old practice of waiting until the crossing had worn down to the maximum allowable extent, by which time severe jolting of the rolling-stock, and consequent wear and tear thereof, resulted.

[621. 133.2 (.73) & 621. 133. 4 (.73)]

Draft appliance returns cinders to the firebox.

(Railway Mechanical Engineer.)

A locomotive front-end arrangement which is designed to retain all cinders in the front end and return them to the firebox for complete combustion has been developed by the J. S. Coffin, Jr., Company, Englewood, N. J. The equipment, which is known as the Superdraft, consists of a separator, through which the front-end gases pass freely to the stack and from which the cinders are diverted by their own inertia, and two steam ejectors, by which the cinders are picked up from the bottom of the smokebox and returned to the firebox through return pipes which pass back through the barrel of the boiler.



Dimensions of Separator

Line	A	B	C	E	F	Line	A	B	C	E	F
						4	80"-95"	36"	18 5/8"	47 3/4"	30"
1	50"-65"	24"	12 3/8"	32 3/8"	18"	5	90"-100"	40"	20 5/8"	52 7/8"	34"
2	60"-75"	28"	14 5/8"	37 1/2"	22"	6	95"-105"	44"	22 5/8"	58"	38"
3	70"-85"	32"	16 5/8"	42 5/8"	26"						

Fig. 1. — Arrangement and functioning of the locomotive superdraft.

The separator replaces all baffle plates and netting as customarily employed in the locomotive front end. It is built-up of top and bottom plates and a frame of light vertical members to which solid and perforated plates are attached by the customary key-bolt fasteners. The top plate is suspended from the top of the locomotive front end, and a tight closure about the extension stack is effected by means of a collar which is key-bolted in place. The nozzle extends up through the bottom plate, which is supported from the bottom of the front end by means of a sleeve which surrounds the nozzle base and by a vertical dividing plate which extends forward on the longitudinal center line of the front end, to which it is attached by welding. The enclosure of the separator back of the center line of the stack is a half cylinder of solid plate. The long streamlined surfaces in front of the center line of the stack and nozzle are closed with perforated plate. There are no other obstructions to the flow of gases from the tube sheet.

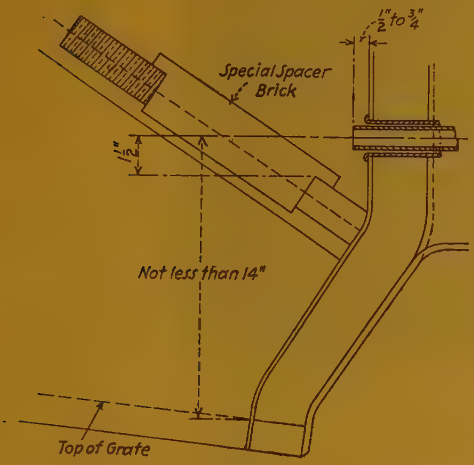


Fig. 2. — How the cinders re-enter the firebox.

When the locomotive is in operation the gases and cinders from the tubes flow forward around the solid cylindrical back plate of the separator, the gases then being drawn through the oblique walls of perforated plate, while the cinders continue toward the front end of the smokebox in a direction approximately parallel to the surfaces of the netting, to fall at the bottom of the smokebox. Here they are picked up by steam-operated ejectors, which blow them back through 2 1/2-inch return pipes to the firebox. The return pipes pass through 3 1/2-inch boiler flues and terminate from 1/2 inch to 3/4 inch inside the rear tube sheet. A special spacer brick is provided in the arch just back of each tube to permit the cinders to fall through to the fire.

In the performance of its primary functions of preventing the discharge of cinders from the stack and reclaiming the heating value of cinders which pass into the front end, the Superdraft equipmen possesses a number of other advantages. Since the clearing of the front end is no longer a function of the drafting equipment, high gas velocities are unnecessary and the separator itself offers very little resistance to the flow of gases to the stack. The relation of the cinder flow to the separator is such that only a small portion of the cinders come in contact with the screen or perforated plate, and then parallel to the surface rather than against it, which materially reduces the netting wear. This also reduces the tendency of the netting to plug. As a further precaution in this respect and also to prevent any water dripping from the stack getting into the front end, a water-tight rim is placed about the edge of the bottom plate of the separator, and any water which drips onto the plate drains into a water-tight well inside the sleeve support which surrounds the exhaust pipe. Such water as accumulates here is evaporated when the smokebox again becomes hot.

The high draft efficiency and elimi-

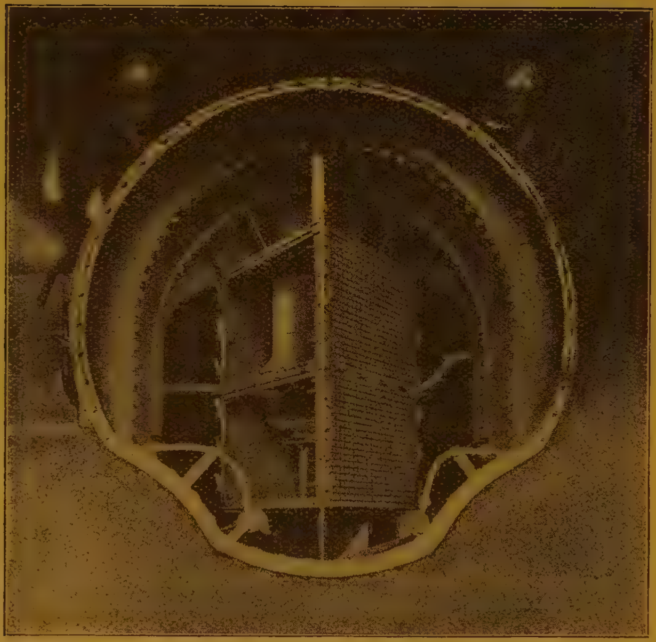


Fig. 3. — Location of the separator and ejectors in the front end.

nation of cinder losses are said to result in a substantial increase in locomotive efficiency. Other advantages are the elimination of fire losses to railway and other adjoining property, reduction in the cost of cleaning ballast, and greater comfort and cleanliness both for passengers and employees.

[313. 625. 143. 3]

Statistics of rail breakages for the year 1931.

We publish hereafter, in the form adopted at the Madrid Congress (1930) [1], the information supplied by member Administrations in connection with the rail fractures which occurred on their lines in 1931.

The publication of these statistics was held back owing to pressure of space consequent upon the publication of the proceedings of the XIIth Congress (Cairo, 1933).

In the tables hereafter, and unless stated otherwise [2]:

Light rails *applies to rails of a weight less than 85 lb. per yard (42.5 kgr. per metre),*

Medium rails, *to rails of 85 to 105 lb. per yard (42.5 to 52.5 kgr. per metre),*

Heavy rails, *to those weighing 106 lb. per yard (53 kgr. per metre) or over.*

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(1) See *Bulletin of the Railway Congress*, December 1930, p. 2236, 2240-2242.
(2) See *Bulletin of the Railway Congress*, March 1926, p. 240.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ARGENTINE. Buenos Ayres and Pacific Railway *		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels *Light*	...	...	...	...	...	...	...	...	...	...	...	...	10	222.5	28.08	10	222.5	28.08	13.8
Medium	...	...	...	...	...	...	1	997.6	0.63	...	...	...	20	997.6	12.53	21	997.6	13.15	17.8-18.8
Heavy	3	1 820.2	1.03	...	...	...	...	...	...	...	...	...	3	1 820.2	1.03	6	1 802.2	2.06	18.8-21.3
Total	3	1 820.2	1.03	...	...	...	1	997.6	0.63	...	...	...	33	3 040 3	6.78	37	3 040.3	7.60	

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of $\leqslant$ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: $\leqslant$ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails*	3	7	...	...	...	10	...
Medium rails	13	8	8	...	...	13	...
Heavy rails	3	3	...	...	...	6	...
		Total	8	...	...	29	...

E. (Particulars apply to 5 1/2 months only.)	*Light.*	*Medium*	*Heavy.*
a) New clean fractures: with internal transverse fissure	...	1	1
without internal transverse fissure	1	...	1
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head: in the head	2	...	1
in the foot	...	2	1
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head: in the web	1	...	...
d) Number of pieces rails are broken into	2	Not broken.	2

Note. — *a*) Light rails = from 50.4 to 54.7 lb. per yard.
Medium rails = from 70.1 to 85 lb. per yard.
Heavy rails = 100 lb. per yard.

b) No tunnels on this system.

* Running lines only.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.						*Maximum axle load*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
BELGIUM. CONGO COLONY. Lower Congo to Katanga Railway. (*Bukama-Sakania line*).		Miles.			Miles.			Miles.			Miles.						Miles.		English tons.
A Rails outside tunnels. *Light* 29.3 kgr. (59.2 lb.)	[illegible]	93.2	...	1	24.9	25	2	201.9	6	5	248.5	12	...	...	...	8	568.5	9	14.8

Number of train-miles : 876 100.
Number of Engl. ton-miles : 137 602 870.

Number of fractures { total : 8. per 10 000 000 tr.-km. or 6 250 000 train-miles : 57. per 1 billion tkm. or 612 000 000 Engl. ton-miles : 35.

	Percentage of fractures in the part		NUMBER OF FRACTURES :				
	covered by the fishplates	clear of the fishplates	on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D. *Light rails* . . .	13.5	87.5	4	3	1	1	7
		Total . . .	4	3	1	1	7

E.	*Light rails.*
a) New clean fractures { with internal transverse fissure	...
a) New clean fractures { without internal transverse fissure	4
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head { in the foot	3
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head { in the head	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head { in the web	1
d) Number of pieces rails are broken into	2

Note. — N breakage reported on the Port Francqui-Bukama line (698 + 41 miles) nor on the Tenke-Dilolo line (324 + 15.5 miles) (L. K. D.).

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CHINA Peking-Hankow Railway *.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		
Rails outside tunnels. *Light*	...	...	...	...	0.3	...	...	7.5	..	...	8.0	...	...	478.4	...	...	494.2	...	...
Rails outside tunnels. *Medium*	...	...	...	...	...	...	...	...	...	...	...	...	...	61.5	...	...	61.5	...	...
Rails outside tunnels. *Heavy*	...	0.8	...	...	17.3	...	...	530.6	...	...	...	...	...	128.1	...	...	676.8	...	...
Total . . .	...	0.8	...	...	17.6	...	...	538.1	...	...	8.0	...	...	668.0	...	...	1 232.5	...	...

* Year 1930.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DENMARK. State Railways.		Miles.			Miles.			Miles.			Miles.			Miles.					
A. Rails outside tunnels *Light*	1	119.9	...	1	92.4	...	5	136.3	...	4	251.3	...	144	614.6	...	155	...	...	...
Medium	...	146.1	...	2	99.0	...	3	126.5	...	...	63.0	...	3	216.2	...	8	...	...	...
Total	1	266.0	...	3	191.4	...	8	262.8	...	4	314.3	...	147	830.8	...	163	...	...	...
B. Rails in tunnels *Light*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Medium	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
C. The whole of A and B *Light*	1	119.9	5.2	1	92.4	6.7	5	136.3	22.8	4	251.3	9.9	144	614.6	147	155	1 214.5	79.94	...
Medium	0	146.1	...	2	99.0	12.6	3	126.5	14.7	...	63.0	...	3	216.2	8.6	8	650.8	...	...
Total	1	266.0	...	3	191.4	9.7	8	262.8	18.9	4	314.3	7.5	147	830.8	111	163	1 865.3	...	...

Number of train-miles: 15 241 020.

Number of English ton-miles: 2 813 780 000.

Number of fractures: total: 163; per 10 000 000 tr.-km. or 6 250 000 train-miles: 67; per 1 billion tkm. or 612 000 000 English ton-miles: 35.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails.*	77 %	23 %	...	...	...	...	...
Medium rails.	50 %	50 %	...	...	...	...	...
		Total	...	...	...	...	...

		Light rails.	*Medium rails.*
E. *a*) New clean fractures	with internal transverse fissure	6	1
	without internal transverse fissure	63	3
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	16	1
	in the head	8	2
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	62	1
	2 pieces	142	8

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			of the rails.			Maximum axle load
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FRANCE. State Railways. (*)		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light*	...	6.2	...	...	54 1	...	1	37.3	17	11	222.5	31	312	4286.9	45	324	4607.0	44	19.7
Medium	16	1212.9	8	11	746.9	9	...	229.9	...	16	996.1	10	12	240.5	31	55	3126.3	10	
Heavy	...	15.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15.5	...	
Total . . .	16	1234.6	8	11	801.0	8	1	267.2	2	27	1218.6	14	324	452·.4	44	379	8048.8	29	
B. Rails in tunnels. *Light*	...	...	...	...	...	...	...	0.6	...	...	...	...	...	1.9	...	...	2.5	...	
Medium	...	0.6	...	...	1.9	...	...	4.3	...	...	4.3	...	...	1.9	...	...	13 0	...	
Heavy	...	26.7	...	3	11.8	158	...	...	...	...	...	...	...	...	...	3	38.5	48	
Total . . .	...	27.3	...	3	13.7	136	...	4.9	...	...	4.3	...	...	3.8	...	3	54.0	34	
C. The whole of A and B. *Light*	...	6.2	...	...	54.1	...	1	37.9	16	11	222.5	31	312	4288.8	45	324	4609.5	44	
Medium	16	1213.5	8	11	748.8	9	...	234.2	...	16	1000.4	10	12	242.4	31	55	3439.3	10	
Heavy	...	42.2	...	3	11.8	158	...	...	...	...	...	...	...	...	...	3	54.0	34	
Total . . .	16	1261.9	8	14	814.7	11	1	272 1	2	27	1222.9	14	324	4531.2	44	382	8102.8	29	

Number of train-miles: 45 954 745.
Number of English ton-miles: 15 632 500 000.

Number of fractures { total: 382.
per 10 000 000 tr.-km. or 6 250 000 train-miles: 52.
per 1 billion tkm. or 612 000 000 English ton-miles: 15.

	Percentage of fractures in the part		NUMBER OF FRACTURES:				
	covered by the fishplates	clear of the fishplates	on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius — Lower rail.	on curves of ⩽ 800 m. (40 chains) radius — Higher rail.	on a rising or falling gradient — ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient — > 10 mm. per m. (1 in 100)
D. *Light rails* . .	28 %	72 %	257	55	12	252	72
Medium rails . .	67 %	33 %	43	10	2	36	19
Heavy rails . .	100 %	...	3	...	...	2	1
Total . . .			303	65	14	290	92
Miles of single track of each class.			6945	1158		7068	1035

	Percentage — *Light.*	*Medium*	*Heavy*
E. *a*) New clean fractures — with internal transverse fissure	11	7	...
— without internal transverse fissure	43	9	34
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head — in the foot	15	2	...
— in the head	12	13	33
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head — in the web	19	51	33

d) Number of pieces rails are broken into	*Light*	*Medium*	*Heavy.*
2 pieces	283	40	2
3 —	27	11	1
4 —	8	3	»
5 —	2	1	»
6 —	1	»	»
7 —	1	»	»
8 —	»	»	»
9 —	»	»	»
10 — and over	2	»	»

(*) Running track only.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Alsace-Lorraine Railways, including the Guillaume-Luxembourg Lines		Miles			Miles			Miles.			Miles.			Miles			Miles.		English tons.
A. Rails outside tunnels. *Light.*	...	...	...	1	15.5	40	3	57.8	32	9	179.0	31	77	1144.5	42	90	1396.8	40	Locos : 18.4 — Wagons : 15.8
Medium.	3	342.4	5	3	299.5	6	4	32.3	77	11	69.0	99	11	331.5	33	32	1074.7	21	
Heavy .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Total . . .	3	342.4	5	4	315.0	8	7	90.1	48	20	248.0	50	88	1476.0	41	122	2471.5	32	
B. Rails in tunnels. *Light.* .	...	...	...	...	1.2	...	...	0.6	...	...	4.4	...	...	2.5	...	...	8.7	...	
Medium.	1	7.5	83	...	3.7	...	...	0.6	...	2	1.2	1000	1	0.3	2 000	4	13.3	186	
Heavy .	...	7.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7.5	..	
Total . . .	1	15.0	42	...	4.9	...	...	1.2	...	2	5.6	...	1	2.8	222		19.5	84	
C. The whole of A and B. *Light.* .	...	...	...	1	16.7	37	3	58.4	32	9	183.5	31	77	1146.9	42	90	1405.5	40	
Medium.	4	349.9	7	3	303.2	6	4	32.9	75	13	70.2	115	12	331.8	36	36	1088.0	23	
Heavy .	...	7.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7.5	...	
Total . . .	4	357.4	7	4	319.9	8	7	91.3	48	22	253.7	54	89	1478.7	41	126	2501.0	33	

Number of train-miles : 18 544 220.
Number of English ton-miles : 7 831 999 000.

Number of fractures { per 10 000 000 tr.-km. or 6 250 000 trains-miles : 42.
per 1 billion tkm. or 612 000 000 English ton-miles : 10.

Note. — This table does not include fractures of *machined* rails in points and crossings, i. e. those of the nose, wing rails, point blades and stock rails.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES : on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails* . . .	69 °/₀	31 °/₀	52	28	10	56	12
Medium rails . .	80.8 °/₀	19.2 °/₀	31	2	3	43	...
Heavy rails . .	...	...	...	...	...	...	...
Total . . .			83	30	13	99	12
Miles of single track of each class.			1886	489.7		1633	208.2

	Light rails.	*Medium rails.*	*Heavy rails.*
E. *a)* New clean fractures { with internal transverse fissure	5.5 °/₀	5.5 °/₀	...
without internal transverse fissure	25.6 °/₀	27.8 °/₀	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head . . . . . . { in the foot	18.9 °/₀	5.6 °/₀	...
in the head	10 °/₀	16.7 °/₀	...
c) Fractures with much rusted old part, *not* extending { in the web	40 °/₀	44.4 °/₀	

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			[illegible]			*Maximum axle load*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Paris Circle Railways (*)		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light*	...	0.50	...	...	...	...	...	0.50	...	...	1.90	...	2	6.70	184.5	2	9.60	129.2	
Medium	...	64.40	...	2	41.80	29.6	...	10.70	...	2	13.20	94.4	...	12.50	...	4	142.60	17.4	
Heavy	...	0.05	...	...	0.01	...	...	...	...	...	...	...	...	...	...	...	0.06	...	
Total	...	64.95	...	2	41.81	29.6	...	11.20	...	2	15.10	82.6	2	19.20	64.6	6	152.26	24.4	
B. Rails in tunnels. *Light*	...	...	...	...	...	...	...	...	...	...	...	...	...	0 25	...	...	0.25	...	
Medium	...	0.16	...	...	0.02	...	...	0.82	...	...	...	...	...	...	...	...	1.00	...	18.9
Heavy	...	4.81	...	...	0.94	...	...	...	...	...	...	...	...	...	...	...	5.75	...	
Total	...	4.97	...	...	0.96	...	...	0.82	...	...	...	...	..	0.25	...	...	7.00	...	
C The whole of A and B *Light*	...	0.50	...	...	...	...	...	0.50	...	...	1 90	...	2	6.95	177 9	2	9.85	125.9	
Medium	...	64.56	...	2	41.82	29.6	...	11.52	...	2	13.20	94.4	...	12.50	...	4	143.60	17.3	
Heavy	...	4.86	...	...	0.95	...	...	...	...	...	...	...	...	...	...	...	5.81	...	
Total	...	69.92	...	2	42.77	29.6	...	12.02	...	2	15.10	82.6	2	19.45	63.7	6	159 26	23.4	

Number of train-miles: 1 815 660.
Number of English ton-miles: 817 336 330.

Number of fractures { total: 6.
per 10 000 000 tr.-km. or 6 250 000 train-miles: 20.53.
per 1 billion tkm. or 612 000 000 English ton-miles: 4.48.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails*	100 %	...	2	...	...	1	...
Medium rails	100 %	...	2	1	1	4	...
Heavy rails	...	...	...	...	...	...	...
Total			4	1	1	5	...
Miles of single track of each class.			116.35	42.91		113.62	...

		Light rails.	*Medium rails.*	*Heavy rails.*
E. *a*) New clean fractures	with internal transverse fissure	...	...	...
	without internal transverse fissure	67 %	50 %	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	...	...	...
	in the head	...	17 %	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	33 %	33 %	...
d) Number of pieces rails are broken into	2 pieces	1	4	...
	3 pieces	1	1	...

* Fractures occurring in the running track (excluding points and crossings).

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	Age of rails: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Est Railway (1).		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		
A. Rails outside tunnels. *Light.*	...	49.1	...	...	59.7	...	...	131.0	...	...	60.9	...	161	2383.5	41.9	161	2684.2	37.2	
Medium.	6	922.5	4.04	4	449 6	5.5	4	362.1	6.8	11	328.0	20.8	109	1201.3	56.3	134	3263.5	25.5	
Heavy (2)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Total . . .	6	971.6	3.8	4	509.3	4.8	4	493.1	5.04	11	388.9	17.5	270	3584.8	46.8	295	5947.7	30.8	
B. Rails in tunnels. *Light.*	...	...	...	...	...	...	...	0.1	...	...	...	...	...	4.4	...	...	4.5	...	...
Medium.	...	0.9	...	...	1.5	...	...	2.7	...	1	2.6	243.9	...	1.8	...	1	9.5	66.6	
Heavy (2)	...	10.6	...	...	16.1	...	...	...	...	...	...	...	...	...	...	...	26.7	...	
Total . . .	...	11.05	...	...	17.6	..	...	2.8	...	1	2.6	243 9	...	6.2	...	1	40.7	15.3	
C. The whole of A and B. *Light.*	...	49.1	...	...	59.7	...	...	131.1	...	...	60.9	...	161	2387.9	41.8	161	2688.7	37.2	
Medium.	6	923.4	4.03	4	451.1	5.5	4	364.8	6.8	12	330.6	22.5	109	1203.1	56.3	135	3273.0	85.6	
Heavy (2)	...	10.6	...	...	16.1	...	...	...	...	...	...	...	...	...	...	...	26.7	...	
Total . . .	6	983.1	3.7	4	526.9	4.7	4	495.9	5.01	12	391.5	19.04	270	3591.0	46.7	296	5988.4	30.7	

Number of train-miles: 39 555 190.
Number of English ton-miles: 18 032 711 500.

Number of fractures per 10 000 000 tr.-km. or 6 250 000 train-miles: 46.49.
Number of fractures per 1 billion tkm. or 612 000 000 English ton-miles: 10.03.

	Percentage of fractures in the part: covered by the fishplates	Percentage of fractures in the part: clear of the fishplates	Number of fractures: on straight lines or curves of > 800 m. (40 chains) radius.	Number of fractures: on curves of ≤ 800 m. (40 chains) radius. Lower rail.	On curves of ≤ 800 m. (40 chains) radius. Higher rail.	On a rising or falling gradient ≤ 10 mm. per m. (1 in 100).	On a rising or falling gradient < 10 mm. per m. (1 in 100).	Number of pieces broken into: 2	3	4	5	6
D. *Light rails* . . .	19.9	80.1	89	46	26	93	9	148	9	3	1	...
Medium rails . .	74	26	115	20	...	70	...	110	19	4	1	1
Heavy rails . .	...	...	...	...	...	...	...	...	...	...	...	...
Total . . .			204	66	26	163	9					
Miles of single track of each class.			4782.4	1206.2		3882.4	358.5					

	Light rails. Percentage	*Medium rails.* Percentage	*Heavy rails.* Percentage
a) New clean fractures with internal transverse fissure	11.8	11.9	...
a) New clean fractures without internal transverse fissure	46.0	25.2	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head: in the foot	18.6	11.1	...
in the head	13.6	9.6	..
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head: in the web	10.0	42.2	...

(1) In running tracks, excluding points and crossings.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Midi Railways (*)		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	...	4.1	...	...	...	...	...	...	...	11	244.2	28	128	1815.6	44	139	2063.9	42	
Medium.	4	429.3	6	19	434.3	27	58	385.7	93	14	72.2	121	...	...	...	95	1321.5	45	
Total . . .	4	433.4	6	19	434.3	27	58	385.7	93	25	316.4	49	128	1815.6	44	234	3385.4	43	
B. Rails in tunnels. *Light.*	...	0.2	...	...	...	...	...	...	...	...	...	...	7	24.9	175	7	25.1	171	17.7
Medium.	2	18.0	69	5	5.0	625	...	2.6	...	...	2.4	...	...	...	..	7	28.0	156	
Total . . .	2	18 2	69	5	5.0	625	...	2.6	...	...	2.4	...	7	24.9	175	14	53.1	163	
C. The whole of A and B. *Light.*	...	4.3	...	...	...	...	...	...	...	11	244.2	28	135	1840.5	46	146	2089.0	43	
Medium.	6	447.3	8	24	439.3		58	388.3	93	14	74.6	117	...	...	...	102	1349.5	47	
Total . . .	6	451.6	8	24	439.3	34	58	388.3	93	25	318.8	49	135	1840.5	46	248	3438.5	45	

Number of train-miles: 21 199 880.
Number of English ton-miles: 8 025 404 900.

Number of fractures { per 10 000 000 tr.-km. or 6 250 000 train-miles: 73.
per 1 billion tkm. or 612 000 000 English ton-miles: 19.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails* . . .	72 %	28 %	112	17	17	62	22
Medium rails . .	88 %	12 %	94	1	7	66	2
		Total . . .	206	18	24	128	24
		Miles of single track of this class.	2670.5	768.0		1336	683

		Percentage of fractures. *Light rails.*	*Medium rails.*	*Heavy rails.*
A a) New clean fractures	with internal transverse fissure	9 %	9 %	...
	without internal transverse fissure	51 %	35 %	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	14 %	16 %	...
	in the head	12 %	18 %	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . .	in the web . . .	14 %	22 %	...

d) Number of pieces rails are broken into.		*Light rails.*	*Medium rails.*
2	pieces	122	68
3	"	15	17
4	"	3	12
5	"	3	4
6	"	2	1
7	"	1	...

* Running track, excluding points and crossings.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	Maximum axle load
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Nord Railway (*)		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	...	...	...	...	...	...	2	314.9	4	...	30.1	...	149	665.2	139.0	151	1010.2	93.0	
Medium.	2	465.4	2.7	34	529.7	39.8	4	498.5	5	11	350.7	19.5	42	1097.7	23.8	93	2942.0	19.6	
Heavy	...	0.06	..	...	...	...	...	...	...	...	0.05	...	...	...	...	...	0.11	...	
Total	2	465.46	2.7	34	529.7	39.8	6	813.4	4.6	11	380.85	17.9	191	1762.9	67.3	244	3952.31	38.4	
B. Rails in tunnels. *Light.*	...	...	...	...	...	...	...	0.12	...	...	...	...	...	...	...	...	0.12	...	
Medium.	...	0.9	...	...	0.6	...	...	3.3	...	...	0.7	...	...	1.7	...	...	7.2	...	18.6
Heavy	...	2.9	...	...	2.4	...	...	...	...	...	...	...	...	...	...	...	5.3	...	
Total	...	3.8	...	...	3.0	...	...	3.42	...	...	0.7	...	...	1.7	...	...	12.62	...	
C. The whole of A and B. *Light.*	...	...	...	...	...	...	2	315.02	4	...	30.1	...	149	665.2	139.0	151	1010.32	93.0	
Medium.	2	466.3	2.7	34	530.3	39.8	4	501.8	5	11	351.4	19.5	42	1099.4	23.8	93	2949.2	19.6	
Heavy	...	2.96	...	...	2.4	...	...	...	...	...	0.05	...	...	...	...	...	5.41	...	
Total	2	469.26	2.7	34	532.7	39.7	6	816.82	4.6	11	381.55	17.9	191	1764.6	67.3	244	3964.93	38.2	

Number of train-miles: 37 383 320.
Number of English ton-miles: 16 564 763 400.

Number of fractures: total: 244; per 10 000 000 tr.-km. or 6 250 000 train-miles: 40; per 1 billion tkm. or 612 000 000 English ton-miles: 9.

	Percentage of fractures in the part covered by the fishplates	Percentage of fractures in the part clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D. *Light rails*	27 %	73 %	105	26	20	64	23
Medium rails	77 %	23 %	81	8	4	53	3
Heavy rails	...	...	...	...	...	...	...
		Total	186	34	24	117	26
		Miles of single track of each class.	3468.5	496.43		2569	317

E.		Percentage: Light rails	Percentage: Medium rails
a) New clean fractures	with internal transverse fissure	12.6	5.4
	without internal transverse fissure	45	19.3
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	18.5	14.0
	in the head	14.6	22.6
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	9.3	38.7

d) Number of pieces rails are broken into:	Number: Light rails	Number: Medium rails
2 pieces	136	62
3 —	10	20
4 —	1	3
5 —	1	8
6 —	1	...
7 —	1	...
8 —	1	...

* Running track only.

ADMINISTRATIONS AND DESCRIPTION OF RAILS.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Maximum axle load
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Paris-Lyons-Mediterranean Railways (*).		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A Rails outside tunnels. *Light.*	..	95.6	...	2	198.2	6.26	3	36.0	51.72	11	266.6	25.64	205	3394.0	37.53	221	3990.4	34.41	19.6
Medium.	10	1182.5	5.25	43	670.5	39.85	8	315.7	15.74	65	1114.8	36.23	218	1901.4	71.24	344	5184.9	41.23	
Heavy	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Total	10	1278.1	4.86	45	868.7	32.18	11	351.7	19.43	76	1381.4	34.18	423	5295.4	49.63	565	9175.3	38.26	
B. Rails in tunnels. *Light.*	...	13.7	...	...	6.2	...	...	6.8	...	...	11.2	...	8	8.7	571.43	8	46.6	106.66	19.6
Medium.	5	45.4	68.49	33	21.7	942.85	30	17.4	1 071.42	4	29.8	81.25	8	39.1	126.98	80	153.4	323.88	
Heavy	...	43.5	...	17	13.0	809.52	...	...	...	...	...	...	...	...	...	17	56.5	188.81	
Total	5	102.6	30 30	50	40.9	757.57	30	24.2	769.23	4	41.0	60.60	16	47.8	207.92	105	256.5	254.23	
C. The whole of A and B. *Light.*	...	109.3	...	2	204.4	6.08	3	42.8	43.48	11	277.8	24.60	213	3402.7	38.89	229	4037.0	35.24	
Medium	15	1227.9	7.59	76	692.2	68.22	38	333.1	70.89	69	1144.6	37.45	226	1940.5	72.36	424	5738.3	49.35	
Heavy	...	43.5	...	17	13.0	809.52	...	...	...	...	...	...	...	...	...	17	56.5	186.81	
Total	15	80.7	6.75	95	909.6	64.89	41	375.9	67.76	80	1422.4	34.94	439	5343.2	51.05	670	9431.8	44.14	

Number of train-miles: 73 210 290.
Number of English ton-miles: 31 632 700 200.
* Excluding points and crossings.

Number of fractures. total: 670. per 100 000 000 tr.-km. or 6 250 000 train-miles: 56.86. per 1 billion tkm. or 612 000 000 English ton-miles: 12.95.

	Percentage of fractures in the part: covered by the fishplates	Percentage of fractures in the part: clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D *Light rails*	45.0	55.0	124	72	33	183	46
Medium rails	82.3	17.7	387	28	9	402	22
Heavy rails	100.0	...	12	5	...	17	...
		Total	523	105	42	602	68
		Miles of single track of each class.	7121.0	2310.8		7918.1	1513.7

		Light rails.	*Medium rails.*	*Heavy rails.*
E. *a)* New clean fractures	with internal transverse fissure	9.8 %	8.0 %	...
	without internal transverse fissure	48.8 %	19.5 %	16.7 %
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	13.4 %	4.5 %	...
	in the head	12 2 %	42.8 %	33.3 %
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	15.8 %	25.2 %	50.0 %

Number of pieces rails are broken into:	*Light rails.*	*Medium rails.*	*Heavy rails.*
2 pieces	185	309	10
3 "	20	73	5
4 "	9	28	1
5 "	3	9	1
6 "	2	3	...
7 "	1	2	...
8 and over	...	...	...

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Paris-Orleans Railway.(*)		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	...	55.4	...	...	422.4	...	5	460.1	7	...	60.2	...	33	2526.4	8	38	3524.5	7	
Medium.	4	721.8	3	9	1098.3	5	6	184.3	20	3	216.0	8	28	900.3	19	50	3120.7	10	
Heavy	...	0.9	...	...	...	...	...	0.2	...	...	...	...	...	...	...	...	1.1	...	
Total . . .	4	778.1	3	9	1520.7	4	11	644.6	10	3	276.2	7	61	3426.7	11	88	6646.3	8	
B. Rails in tunnels. *Light.*	...	...	...	...	0.1	...	...	0.7	...	...	0.4	...	...	4.8	...	...	6.0	...	
Medium.	2	4.2	285	1	2.8	222	...	0.9	...	...	3.7	...	4	7.4	333	7	19.0	225	18 7
Heavy	...	13.0	...	3	42.6	44	5	10.3	294	...	...	...	...	...	...	8	65.9	75	
Total . . .	2	17.2	71	4	45.5	54	5	11.9	263	...	4.1	...	4	12.2	200	15	90.9	102	
C. The whole of A and B. *Light.*	...	55.4	...	...	422.5	...	5	460.8	7	...	60.6	...	33	2531.2	8	38	3530.5	7	
Medium.	6	726.2	5	10	1101.1	6	6	185.2	20	3	219.7	8	32	907.7	21	57	3139.9	11	
Heavy	...	13.9	...	3	42.6	44	5	10.5	294	...	...	...	...	...	...	8	67.0	74	
Total . . .	6	795.5	4	13	1566.2	5	16	656.5	15	3	280.3	7	65	3628.9	12	103	6737.4	10	

Number of train-miles: 39 915 722.

Number of English ton-miles: 20 083 168 900.

Number of fractures: total: 103. per 10 000 000 tr.-km. or 6 250 000 train-miles: 16.03. per 1 billion tkm. or 612 000 000 English ton-miles: 3.13.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D. *Light rails* . . .	39.47 %	60.53 %	18	12	8	24	11
Medium rails . .	42.10 %	57.90 %	42	8	7	41	8
Heavy rails . .	62.50 %	37.50 %	6	2	...	5	1
		Total . . .	66	22	15	70	20
		Miles of single track of each class.	5405.3	1332.1		4729.4	1107.0

E.	Percentage: *Light*	*Medium*	*Heavy*
a) New clean fractures with internal transverse fissure	13.16	8.77	...
a) New clean fractures without internal transverse fissure	28.95	17.55	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head . . . . in the foot	21.05	26.31	12.50
in the head	26.32	17.55	12.50
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . . in the web	10.52	29.82	75.00

d) Number of pieces rails are broken into	*Light rails.*	*Medium rails.*	*Heavy rails.*
2 pieces	35	57	8
3 —	...	...	...
4 —	...	...	...
5 —	2	...	...
6 —	...	...	...
7 —	...	...	...
8 —	1	...	...
9 — and over	...	...	...

* Running track only.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			of the rails.			*Maximum axle load.*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ALGERIA and TUNIS		Miles			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
Algerian State Railways.																			
a) Algiers District																			
A. Rails outside tunnels. *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	3	303 2	6.14	3	303.2	6.14	13.8
Medium.	...	...	...	...	...	...	...	...	...	...	98.2	...	...	...	...	...	98.2	...	
Total . . .	...	...	...	...	...	...	...	...	...	...	98.2	...	3	. .	6.14	3	401.4	4.65	
B. Rails in tunnels. *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13.8
Medium.	...	...	...	...	...	...	...	...	...	...	5	...	...	...	...	...	5	...	
Total . . .	...	...	...	...	...	...	...	...	...	...	5	...	...	...	...	...	5	...	
C. The whole of A and B. *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	3	303.2	6.14	3	303.2	6.14	
Medium.	...	...	...	...	...	...	...	...	...	...	103.2	...	...	...	...	...	103.2	...	
Total . . .	...	...	...	...	...	...	...	...	...	...	103.2	...	3	303.2	6.14	3	406.4	4.28	

Number of train-miles: 2 653 260.

Number of English ton-miles: 261 135 445.

Number of fractures: total: 3. per 10 000 000 tr.-km. or 6 250 000 train-miles: 7. per 1 billion tkm. or 612 000 000 English ton-miles: 6.73.

	Percentage of fractures in the part		NUMBER OF FRACTURES:				
	covered by the fishplates	clear of the fishplates	on straight lines or curves of > 800 m. (40 chains) radius	on curves of ≤ 800 m. (40 chains) radius: Lower rail.	on curves of ≤ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ≤ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D *Light rails.*	...	100 %	2	1	...	2	1
Medium rails.	...	100 %	...	...	...	...	...
		Total . . .	2	1	...	2	1
Miles of single track of each class . . .		*Light* . .	223.1	80.2		204.7	98.5
		Medium .	57.8	45.1		42 6	56.2

		Light rails.	*Medium rails.*
D. *a)* New clean fractures	with internal transverse fissure	...	...
	without internal transverse fissure	...	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	...	...
	in the head	2	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	1	...
d) Number of pieces rails are broken into		...	...

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
b) Oran District.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	...	51.6	...	...	102.1	...	...	105.0	...	...	55.4	...	15	503.5	18 51	15	817.6	11.40	10.4
B Rails in tunnels. *Light.*	...	...	...	...	0.1	...	...	0.1	...	...	...	...	...	...	...	...	0.2	...	...
C. The whole of A and B *Light.*	...	51 6	...	...	102.2	...	..	105.1	...	...	55.4	..	15	503.5	18.51	15	817.8	11.40	...

Number of { train-miles : 1 729 820. English ton-miles : 222 792 650.

Number of fractures { total : 15. per 10 000 000 tr.-km. or 6 250 000 train-miles : 53.883. per 1 billion tkm. or 612 000 000 English ton-miles : 41.175.

	Percentage of fractures in the part: covered by the fishplates	Percentage of fractures in the part: clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D. *Light rails.*	...	100 %.	14	1	...	14	1
	Total		14	1	...	14	1
	Miles of single track of each class.		652.8	165.0		422.5	225.3

		Light rails.	
E. a) New clean fractures	with internal transverse fissure	...	...
	without internal transverse fissure	11	73.33 %
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	4	26.67 %
	in the head	...	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	...	...
d) Number of pieces rails are broken into		...	...

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
c) *Bône district*		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	9	269.2	20.77	9	269.2	20.77	
A. Rails outside tunnels. *Medium.*	...	50.8	...	...	48.8	...	...	39.3	...	...	...	...	...	...	...	...	138.9	...	
Totaux . . .	...	50.8	...	...	48.8	...	...	39 3	...	...	...	...	9	269.2	20.77	9	408.1	13.70	
B. Rails in tunnels. *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	...	1.2	...	...	1.2	...	13.8
B. Rails in tunnels. *Medium.*	...	...	...	...	1.1	...	...	1.4	...	...	...	...	...	...	...	...	2.5	...	
Totaux . . .	...	...	...	...	1.1	...	...	1.4	...	...	...	...	...	1.2	...	...	3.7	...	
C The whole of A and B *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	9	270.4	...	9	270.4	...	
C The whole of A and B *Medium.*	...	50 8	...	...	49.9	...	...	40.7	...	...	...	...	...	...	...	...	141.4	...	
Total . . .	...	50.8	...	...	49.9	...	...	40.7	...	...	...	...	9	270.4	20.68	9	411.8	13.57	

Number of train-miles: 1 316 582.
Number of English ton-miles: 347 935 950.

Number of fractures. { total: 9. per 10 000 000 tr.-km. or 6 250 000 train-miles: 42.47.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D { *Light rails.* . .	...	20.77 %	...	4	5	7	2
{ *Medium rails* . .	...	...	...	...	...	...	...
		Total . . .	...	4	5	7	2
		Miles of single track each class.	284.0	127.8		296.8	115.0

	Light rails.	*Medium rails.*
E. *a*) New clean fractures { with internal transverse fissure	2	...
{ without internal transverse fissure	6	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head . . . . { in the foot	1	...
{ in the head	...	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . . { in the web	...	...
d) Number of pieces rails are broken into	2	...

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			The whole of the rails.			*Maximum axle load*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
d) Constantine District		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
Rails outside tunnels. *Medium.*	...	83.9	...	...	0.6	...	...	19.3	...	...	106.9	...	3	369.7	5.04	3	580.4	5.04	13.8
Rails outside tunnels. *Heavy* .	...	8.1	...	...	0.6	...	...	15.5	...	...	...	...	...	...	...	...	24.2	...	13.8
Total . . .	...	92.0	...	...	1.2	...	...	34.8	...	..	106.9	...	3	369.7	5.04	3	604.6	5.04	

Number of train-miles : 1 954 265.

Number of fractures { total : 3. per 10 000 000 tr.-km. or 6 250 000 train-miles : 9.53.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES : on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D. *Medium rails* . .	67	33	...	...	...	...	...
D. *Heavy rails* . .	...	...	2	1	...	...	...
		Total . . .	2	1	...	...	...
		Miles of single track of each class.	495.9	108.7		418.2	155 3

		Light rails.	*Medium rails.*
E. *a)* New clean fractures	with internal transverse fissure	...	...
	without internal transverse fissure	...	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot . . .	...	...
	in the head	2 (67 %)	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . .	in the web	1 (33 %)	...
d) Number of pieces rails are broken into		2	...

French Colonies and Protectorates

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AFRICA. Colonial Railways in French West Africa.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
a) Thiès to the Niger																			
Light rails (Vignole 41 lb. per yard, 19 ft. 8 in. long)	...	...	...	...	...	...	...	...	...	...	...	...	56	370.3	93.95	56	370.3	93.95	10.8

Number of train-miles: 1 303 892. Number of fractures per 10 000 000 tr.-km. or 6 250 000 train-miles: 267.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D.[1] *Light rails.*	...	100 %.	...	...	...	...	...

E.		*Light rails.*
a) New clean fractures	with internal transverse fissure	17
	without internal transverse fissure	12
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	24 = 4.02 %.
	in the head	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head		3 = 0.50 %.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
b) Conakry to the Niger		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
Light rails (50 lb. per yard 26 ft. 3 in. long).	...	...	...	...	...	...	...	...	...	...	...	...	1	365.4	1.7	1	365 4	1.7	9.8

Number of train-km.: 342 687.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			The whole of the rails.			Maximum axle load.
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
c) Réseau des voies ferrées d'intérêt général, Dahomey.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
22 kgr. (44.3 lb. per yard) rails	...	...	...	...	...	...	...	...	...	...	...	...	1	182 1	3.41	1	182.1	3.41	...
d) Ivory Coast Railway.								Over 10 years.											
Vignole, 19 ft. 8 in. long	...	...	...	...	...	...	1	182.7	...	...	...	...	...	...	...	...	...	...	*Golwe engines 11.8 Engl. tons* (on heaviest axle when fully loaded: 13,7 Engl. tons).
Vignole, 26 ft. 3 in. long	...	...	...	...	16.2	...	...	16.2	...	...	...	...	...	...	...	...	...	...	
Vignole, 32 ft. 9 in. long	...	...	...	...	1.8	...	...	...	...	...	...	...	...	...	...	...	...	...	
Standard, 26 ft. 3 in. long	...	...	...	...	12.7	...	...	...	...	...	...	...	...	...	...	...	...	...	
Standard, 39 ft. 4 1/2 in. long	...	...	...	...	73.4	...	...	...	...	...	...	...	...	...	...	...	...	...	
German War Reparations	2	80.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Weight of rails: Vignole, 25.5 kgr. (51.4 lb. per yard) . . Standard, 26 1 kgr. (52.6 lb. per yard) . . Reparations: 30 kgr. (60.5 lb. per yard) . .																			
Total . . .	2	80.5	...	...	104.1	...	1	198.9	...	...	...	...	...	...	...	...	...	...	

Number of train-miles: 523 830.

Number of factures { total: 3. per 10 000 000 tr.-km. or 6 250 000 train-miles: 35.6.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
INDO-CHINA Indo-Chinese Colonial Railways														Miles.			Miles.		English tons.
a) Northern System (*)																			
A. Rails outside tunnels. } *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	28	381.5	45.60	28	381.5	45.60	10.4

Number of train-miles : 1 447 885.

Number of English ton-miles : 222 821 000.

Number of fractures. { total : 28. per 10 000 000 tr.-km. or 6 250 000 train-miles : 120.176. per 1 milliard tkm. or 612 000 000 English ton-miles : 76.851.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES : on straight lines or curves of > 800 m. (40 chains) radius	on curves of ≮ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ≮ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails* . . .	32.14 %	67.86	15	7	6	21	7
	Miles of single track of each class		510	95.5		575.4	28.6

		Light rails.
E. *a*) New clean fractures	with internal transverse fissure	1
	without internal transverse fissure	6
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	13
	in the head	7
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	1
d) Number of pieces rails are broken into	cracked	12
	2 pieces	14
	4 pieces	2

* Hanoi-Nacham line.
Hanoi-Tourane line and branches.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
					Miles.						Miles.			Miles.			Miles.		English tons.
b) **Southern System (*).**																			
A. Rails outside tunnels. *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	1	43.5	14.3	1	43.5	14.3	9.8
A. Rails outside tunnels. *Medium.*	...	...	...	...	...	...	...	...	...	7	262.4	16.5	...	...	...	7	262.4	16.5	
Total . . .	...	...	...	...	...	...	...	...	...	7	262.4	16.5	1	43.5	14.3	8	305.9	16.3	
B. Rails in tunnels. *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9.8
B. Rails in tunnels. *Medium.*	...	...	...	1	13.4	46.3	...	...	...	...	...	...	...	...	...	1	13.4	46.3	
Total . . .	...	...	...	1	13.4	46.3	...	...	...	...	...	...	...	...	...	1	13.4	46.3	
C. The whole of A and B. *Light.*	...	...	...	...	...	...	...	...	...	...	...	...	1	43.5	14.3	1	43.5	14.3	
C. The whole of A and B. *Medium.*	...	...	...	1	13.4	46.3	...	...	...	7	262.4	16.5	...	...	...	8	275.8	18.0	
Total . . .	...	...	...	1	13.4	46.3	...	...	...	7	262.4	16.5	1	43.5	14.3	9	319.3	17.5	

Number of train-miles: 784 155.
Number of English ton-miles: 85 036 150.

Number of fractures { total: 9.
per 10 000 000 tr.-km. or 6 250 000 train-miles: 71.
per 1 billion tkm. or 612 000 000 English ton-miles: 64.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ≤ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ≤ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails* . . .	...	100	1	...	...	1	4 (of which 1 on rack railway on 1 in 8 gradient.
D. *Medium rails* . . .	...	...	7	1	...	4 (on level)	
		Total . . .	8	1	...	5	4

E.	*Light rails.*	*Medium rails.*
a) New clean fractures { with internal transverse fissure	1	...
without internal transverse fissure	...	7
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head . . . . { in the foot	...	1
in the head	...	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . . { in the web	...	...
d) Number of pieces rails are broken into	...	...

* Saigon-Mytho line.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			The whole of the rails.			*Maximum axle load.*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
Compagnie française des Chemins de fer de l'Indochine et du Yunnan.																			
Light rails. .	...	23.7	...	...	1.8	...	...	...	...	...	...	...	8 broken; 74 cracked.	505.1	9 broken; 91 cracked.	...	...	...	10.6

Number of train-km. : 1 608 325.

Number of fractures { 8 rails broken. / 74 rails cracked.

Number of fractures per 10 000 000 tr.-km. or 6 250 000 train-miles . . . . { 31 rails broken. / 285 rails cracked.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			The whole of the rails.			*Maximum axle load.*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
GREAT BRITAIN. London and North Eastern Railway.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	...	12.33	...	...	33.62	...	...	24.95	...	...	76.55	...	...	1 523.48	...	...	1 670.93	...	20
Medium.	6	1 538.47	2.44	8	1 404.27	3.56	7	1 164.52	3.76	3	1 434.80	1.31	14	3 329.41	2.63	38	8 871.47	2.68	22 1/2
Total . . .	6	1 550.80	2.42	8	1 437.89	3.48	7	1 189.47	3.68	3	1 511.35	1.24	14	4 852.89	1.80	38	10 542.40	2.25	
B. Rails in tunnels. *Light.*	...	...	...	...	0.42	...	...	...	...	...	...	...	...	2.06	...	...	2.48	...	20
Medium.	2	55.18	22.65	2	30.75	40.65	...	10.47	...	...	3 50	...	...	2.10	...	4	102.00	24.50	22 1/2
Total . .	2	55.18	22.65	2	31.17	40.00	...	10.47	...	...	3.50	...	...	4.16	...	4	104.48	23.92	
C. The whole of A and B. *Light.*	...	12.33	...	...	30.04	...	...	24.95	...	...	76.55	...	...	1 525.54	...	...	1 673.41	...	20
Medium.	8	1593.65	3.14	10	1 435.02	4.36	7	1 174.99	3.72	3	1 438.30	1.30	14	3 331.51	2.63	42	8 973.47	2.93	22 1/2
Total . . .	8	1 605.98	3.11	10	1 469.06	4.25	7	1 199.94	3.65	3	1 514.85	1.24	14	4 857.05	1.80	42	10 646.88	2.47	

Number of train-miles: 104 515 883.

Number of English ton-miles: 11 784 885 179.

Number of fractures { total: 42.
per 10 000 000 tr.-km. or 6 250 000 train-miles: 2.51.
per 1 billion tkm. or 612 000 000 English ton-miles: 2.18.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D *Light rails.* . .	...	...	...	...	...	...	...
Medium rails . .	9.52 %	90.48 %	38	1	3	2	33
Total . . .			38	1	3	2	33
Miles of single track of each class.			9 469	1 178		1 779	7 006

		Light rails.	*Medium rails.*
E. *a)* New clean fractures	with internal transverse fissure	...	...
	without internal transverse fissure	...	28
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	...	3
	in the head	...	3
	both in the head and the foot	...	7
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . .	in the web	...	1
		...	91

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			of the rails.			Maximum axle load
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		Tonnes
INDIA, DOMINIONS, PROTECTORATES & COLONIES.																			
AFRICA.																			
Sudan Railways (*)																			
Light rails. 50 lb.	...	277.8	...	1	215.6	2.23	...	...	...	...	5.0	...	3	794.2	2.35	4	1 292.6	1.92	12.2
Light rails. 75 lb.	...	6.8	...	...	65.3	...	...	17.4	...	1	25.0	25 0	4	553.5	4.49	5	668.0	4.65	15.8
Total . . .	...	284.6	...	1	280.9	2.21	...	17.4	...	1	30.0	20.83	7	1 347.7	3.23	9	1 960.6	2.85	

Number of train-miles: 1 579 243.

Number of English ton-miles: 662 731 500.

Number of fractures { total: 9. per 10 000 000 tr.-km. or 6 250 000 train-miles: 35.4. per 1 billion tkm. or 612 000 000 English ton-miles: 8.3.

	Percentage of fractures in the part		NUMBER OF FRACTURES:				
	covered by the fishplates	clear of the fishplates	on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D *50 lb. rails* . .	50 %	50 %	4	...	...	4	...
D *75 lb. rails* . .	...	100 %	5	...	...	5	...
		Total . . .	9	...	...	9	...

E		*75. lb. rails.*	*50. lb. rails.*
a) New clean fractures	with internal transverse fissure	1	1
	without internal transverse fissure	...	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	...	2
	in the head	...	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . .	in the web	...	...
d) Crushed or split head		3	2

* Sidings excluded.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	Maximum axle load.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
INDIA.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
Bombay, Baroda and Central India Railway (*).																			
I. — Broad gauge.																			
A. Rails outside tunnels. } Medium.	...	...	...	...	...	...	...	...	...	...	...	...	5	1 294.179	2.414	5	1 294.174	2.414	17.75
II. — Metre gauge																			
Light rails (**).																			
41 1/4 lb. per yard . . .	...	...	...	...	...	...	...	...	...	...	...	...	15	1 111.98	8.43	15	1 111.98	8.43	8
50 lb. per yard	...	...	...	...	...	...	...	...	...	...	...	...	20	1 316.88	9.49	20	1 316.88	1 316.88	10
60 lb. per yard	...	...	...	...	...	...	...	...	...	...	...	...	...	464.21	...	...	461.21	...	12
	...	...	...	...	...	...	...	..	...	...	...	...	35	2 893.07	7.56	35	2 893 07	7.56	

Number of train-miles { broad gauge : 7 680 528. metre gauge : 9 668 000.

Number of English ton-miles { broad gauge : 3 365 627 328.

Number of fractures { total : B. G., 5; M. G., 35. per 10 000 000 tr.-km. or 6 250 000 train-miles : B. G., 4.06; M. G., 22.62. per 1 billion tkm. or 612 000 000 English ton-miles : B. G., 0.90.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES : on straight lines or curves of > 800 m. (40 chains) radius	on curves of ≤ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ≤ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. Medium rails (B. G.) . .	...	100 %	100 %	...	...	100 % (***)	...

		Medium rails.	(**) Metre gauge (*light rails*).
E. a) New clean fractures { with internal transverse fissure	Broad gauge lines.	...	All fractures except one were outside the portion covered by fishplates. Percentage of fractures according to appearance of fractures is not available.
without internal transverse fissure		4	
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head . . . . { in the foot		1	
in the head		...	
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . . { in the web		...	
d) Number of pieces rails are broken into		2	

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Maximum axle load
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Madras and Southern Mahratta Railway.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	1	352.09	1.77	1	318.22	1.96	...	115.870	...	...	198.88	...	20	1833.46	6.82	22	2818.520	4.88	17.50
Medium.	...	247.02	...	1	144 50	4.34	...	55.125	...	...	...	...	...	...	...	1	446.645	1.40	17.95
Total	1	599.110	1.04	2	462.72	2.70	...	170.995	...	...	198.88	...	20	1833.46	6.82	23	3265.165	4.40	17.95
B. Rails in tunnels. *Light.*	...	0.68	...	...	0.03	...	...	0.38	...	...	0.62	...	...	0.56	...	...	2.27	...	12 00
Medium.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	...	0.68	...	...	0.03	...	...	0.38	...	...	0 62	...	...	0.56	...	...	2.27	...	12.00
C. The whole of A and B. *Light.*	1	352.77	1.77	1	318.25	1.96	...	116.250	...	...	199.5	...	20	1834.02	6.82	22	2820.790	4.88	17.50
Medium.	...	247.02	...	1	144.50	4.34	...	55.125	...	...	...	...	...	...	...	1	446.645	1.40	17.95
Total	1	599.79	1.04	2	462 75	2.70	...	171.375	...	...	199.5	...	20	1834.02	6.82	23	3267.435	4.40	17.95

Number of train-miles: 13 945 400.

Number of English ton-miles: 5 590 228 000.

Number of fractures: total: 23. per 10 000 000 tr.-km. or 6 250 000 train-miles: 10.31. per 1 billion tkm. or 612 000 000 English ton-miles: 2.52.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails*	13.64	86.36	22	...	...	14	...
Medium rails	...	100	1	...	...	...	...
		Total	23	...	...	14	...
	Mileage of single track of each class.		3067.935	199.50		1880.38	117.43

E.	RAILS: Light rails.	Medium rails.
a) New clean fractures — with internal transverse fissure	11	...
a) New clean fractures — without internal transverse fissure	4	1
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head — in the foot	5	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head — in the head	1	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head — in the web	1	...
d) Number of pieces rails are broken into	Each 2 pieces	Each 2 pieces

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
North Western Railway.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	4	148.68	16.8	...	356.56	...	...	148.10	...	1	515.75	1.2	28	3673.27	4.8	33	4842 36	4.2	17.0
Medium	3	418.80	4 5	4	490.35	5.1	3	486.48	3.85	2	388.31	3.2	13	1066.09	7.6	25	2850.03	5.5	22.5
Total . . .	7	567.48	...	4	846.91	...	3	634.58	...	3	904.06	...	41	4739.36	...	58	7692.39	...	...
B. Rails in tunnels. *Light.*	...	...	...	...	0.25	...	...	...	...	...	1.75	...	...	11.7	...	...	13.7	...	17.0
Medium.	...	...	...	...	2.80	...	...	2.06	...	...	0.08	...	...	0.96	...	...	5.90	...	22.5
Total . . .	...	...	...	...	3.05	...	...	2.06	...	...	1.83	...	...	12.66	...	...	19 6	...	...
C. The whole of A and B. *Light.*	4	148.68	16.8	...	356.81	...	...	148.10	...	1	517.50	1.2	28	3684.97	4.75	33	4856.06	4.25	17.0
Medium.	3	418.80	4.5	4	493.15	5.07	3	488.54	3.83	2	388.39	3.2	13	1067.05	7.6	25	2855.93	5 47	22.5
Total . . .	7	567.48	...	4	849.96	...	3	636.64	...	3	905.89	...	41	4752.02	...	58	7711.99	...	...

Number of train-miles: 23 416 964.

Number of English ton-miles: 2 643 521 575.

Number of fractures { total: 58.
per 10 000 000 tr.-km. or 6 250 000 train-miles: 15.4.
per 1 billion tkm. or 612 000 000 English ton-miles: 13.4.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails* . . .	...	100	28	3	2	3	30
Medium rails . .	...	100	25	...	...	...	25
Total . . .			53	3	2	3	55
Miles of single track of each class.			7163.3	548.7		878.00	6834

		Light rails.	*Medium rails.*
E. a) New clean fractures	with internal transverse fissure . . .	6	7
	without internal transverse fissure . . .	7	13
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head . . .	in the foot . . .	18	5
	in the head . . .	1	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . .	in the web . . .	1	...

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	Rails in use for: Less than 5 years. Number of fractures.	5 to 10 years. Number of fractures.	10 to 20 years. Number of fractures.	20 to 30 years. Number of fractures.	More than 30 years. Number of fractures.	TOTAL.	Approximate length of the lines considered as single track.	Number of fractures per 1 000 km. or 625 miles	*Maximum axle load in service.*
1	2	3	4	5	6	7	8	9	10
ITALY. State Railways. (*)							Miles.		English tons.
Light rails	1	...	15	61	555 (**)	632	7 709.5 of which 250.4 in tunnels	50.9	16.2
Medium rails:									
In tunnels	...	18	150	12	...	180	359.2	311.4 } 27.5	19.7
In the open	2	5	15	11	...	33	4 446.6	4.6 }	
Total . . .	2	23	165	23	...	213	4 705.8	27.5	...
Total general . . .	3	23	180	84	555	845	12 415.3	41.8	...

Number of train-miles: 80 819 070.
Total number of fractures: 845.

Number of fractures per 10 000 000 tr.-km. or 6 250 000 train-miles: 64.9.

* Standard gauge. — ** Most of these rails were put into service more than forty years ago

Characteristics of fractures of medium rails.

Fractures in the part of the rail:
— Covered by the fishplates: 178 = 83.6 %.
— Clear of the fishplates: 35 = 16.4 %.

— New and clean breaks through the whole of the rail section: 63 = 29.6 %.
— Fractures with old part: 150 = 70.4 %.

Rails broken into 2 pieces: 177 = 83.1 %.
Rails broken into 3 pieces: 24 = 11.3 %.
Rails broken into 4 pieces: 10 = 4.7 %.
Rails broken into 6 pieces: 2 = 0.9 %.

New and clean breaks through the whole of the rail section: with oval mark.	without oval mark.	Fractures with old part extending to the outer surface: of the foot.	of the head.	Fractures with much rusted portion not extending to the outer face of the foot or head of the rail.
22 = 10.3 %	41 = 19.3 %	28 = 13.1 %	79 = 37.1 %	43 = 20.2 %

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
JAPAN. Japanese Government Railways. **Year 1930.**		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons
A. Rails outside tunnels. *Light* . .	22	2 482.9	5.5	78	3 195.1	15.1	35	1 481.6	14.7	59	959.8	38.2	120	1 412.1	52.8	314	9 531.5	20.5	
Medium .	5	720.2	4.3	...	12.4	...	1	16.4	37.9	...	...	...	...	...	...	6	749.0	5.0	
Total . . .	27	3 203.1	5.2	78	3 207.5	15.1	36	1 498.0	14.9	59	959.8	38.2	120	1 412.1	52.8	320	10 280.5	19.3	
B. Rails in tunnels. *Light* . .	3	129.5	14.4	143	91.5	971.1	10	34.9	178.1	5	4.7	661.1	1	9.2	67.4	162	269.8	373.1	
Medium .	5	30.2	102.9	12	1.2	6434.3	...	...	...	...	...	...	...	...	...	17	31.4	337.0	
Total . . .	8	159.7	31.1	155	92.7	1039.3	10	34.9	178.1	5	4.7	661.1	1	9.2	67.4	179	301.2	369.4	16.5
C. The whole of A and B. *Light* . .	25	2 612.4	6.0	221	3 286 6	41.8	45	1 516.5	18.5	64	964.5	41.2	121	1 421.3	52.9	476	9 801.3	30.2	
Medium .	10	70.4	8.3	12	13.6	548.0	1	16.4	38.0	...	...	...	...	...	...	23	780.4	18.3	
Total . . .	35	3 362.8	6.5	233	3 300.2	43.9	46	1 532.9	18.5	64	964.5	41.2	121	1 421.3	52.9	499	10 581.7	29 3	

Number of train-miles : 114 489 024.

Number of English ton-miles : 41 277 169 500.

Number of fractures { total : 507 (8 unknown). per 10 000 000 tr.-km. or 6 250 000 train-miles : 27.5. per 1 billion tkm. or 612 000 000 ton-miles : 7.51.

	Percentage of fractures in the part: covered by the fishplates	Percentage of fractures in the part: clear of the fishplates	NUMBER OF FRACTURES : on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D. *Medium rails* . .	24 %	76 %	289	59	128	315	169
Light rails. . .	87 %	13 %	21	1	1	23	...
		Total . .	310	60	129	338	169
	Miles of single track of each class.		8 672.0	1 909.7		9 007.6	1 574.1

E. *a*), *b*), *c*), *d*). — No data.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Japanese Government Railways. Year 1931		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons
A. Rails outside tunnels. *Light*	37	2 387.0	9.6	80	3 670.9	13.5	51	1 562.3	20.3	45	824.9	33.9	158	1 160.8	34.6	371	9 605.9	24.0	16.5
A. Rails outside tunnels. *Medium*	2	828.0	1.5	1	104.3	6.0	...	13.6	...	...	...	...	...	...	...	3	945.9	2.0	
Total	39	3 215.0	7.5	81	3 775.2	13.3	51	1 575.9	20.3	45	824.9	33.9	158	1 160.8	84.6	374	10 551.8	22.0	
B. Rails in tunnels. *Light*	7	98.3	44.2	56	133.6	260.5	45	34.9	800.5	5	4.8	642.8	4	3.6	698.3	117	275.2	264.1	
B. Rails in tunnels. *Medium*	3	31.4	59.4	5	10.9	285.2	...	...	...	...	...	...	...	...	...	8	42.3	117.6	
Total	10	129.7	47.9	61	144.5	262.3	45	34.9	800.5	5	4.8	642.8	4	3.6	698.3	125	317.5	244.6	
C. The whole of A and B. *Light*	44	2 485.3	11.0	136	3 804.5	22.2	96	1 597.2	37.3	50	829.7	37.4	162	1 164.4	86.5	488	9 881.1	30.7	
C. The whole of A and B. *Medium*	5	859.4	3.6	6	115.2	32.4	...	13.6	...	...	...	...	...	...	...	11	988.2	6.9	
Total	49	3 344.7	9.1	142	3 919.7	22.5	96	1 610.8	37.0	50	829.7	37.4	162	1 164.4	86.5	499	10 869.3	28.5	

Number of train-miles: 117 114 025.

Number of English ton-miles: 40 935 620 500.

Number of fractures: total: 503 (4 unknown). per 10 000 000 tr.-km. or 6 250 000 train-miles: 26.7. per 1 billion tkm. or 612 000 000 English ton-miles: 7.50.

	Percentage of fractures in the part: covered by the fishplates	Percentage of fractures in the part: clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D. *Light rails.*	37.4 %	62.6 %	304	87	101	344	148
D. *Medium rails.*	63.5 %	36.5 %	10	...	1	11	...
		Total	314	87	102	355	148
		Miles of single track of each class					

E. *a*), *b*), *c*), *d*). — No data.

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			The whole of the rails.			*Maximum axle load*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
KOREA. Government General of Chosen, Railway Bureau.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	5	344.2	9.1	22	100.8	130.2	97	207.9	291.6	40	323.9	77.2	28	674.5	25.9	192	1651.3	72.3	
Medium.	...	75.3	...	...	35.8	...	...	...	...	...	...	...	...	...	...	...	111.1	...	
Total	5	419.5	7.4	22	136.6	96.0	97	207.9	291.6	40	323.9	77.2	28	674.5	25.9	192	1762.4	67.4	
B. Rails in tunnels. *Light.*	...	9.8	...	1	14.3	43.7	...	6.1	...	...	10.4	...	...	0.8	...	1	41.4	15.1	
Medium.	...	8.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8.8	...	19.0
Total	...	18.6	...	1	14.3	43.7	...	6.1	...	...	10.4	...	...	0.8	...	1	50.2	12.4	
C. The whole of A and B. *Light.*	5	354.0	8.8	23	115.1	119.5	97	214.0	283.3	40	334.3	74.8	28	675.3	25.9	193	1692.7	70.9	
Medium.	...	84.1	...	...	35.8	...	...	...	...	...	...	...	...	...	...	...	119.9	...	
Total	5	438.1	7.1	23	150.9	91.1	97	214.0	283.3	40	334.3	74.8	28	675 3	25.9	193	1812 6	66.2	

Number of train-miles: 8 823 014.

Number of English ton-miles: 738 905 000.

Number of fractures: total: 193. per 10 000 000 tr.-km. or 6 250 000 train-miles: 135.9. per 1 billion tkm. or 612 000 000 English ton-miles: 1.6.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails*	22.8 %	77.2 %	147	32	14	148	45
Medium rails	...	...	...	...	...	...	...
		Total	147	32	14	148	45
		Miles of single track of each class.	1267.00	545.6		1517.5	295.1

E.		*Light rails.*	*Medium rails.*
a) New clean fractures	with internal transverse fissure	8	...
	without internal transverse fissure	3	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	62	...
	in the head	71	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	49	...
d) Number of pieces rails are broken into		...	...

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	[illegible]	3	4		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
HOLLAND. Netherlands Railways.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light.*	5	209.1	15	24	367.2	40	6	182.7	20	31	618.3	31	130	970.6	83	...	...	...	15.7
Medium.	4	241.7	10	12	252.3	30	7	144.2	30	3	277.8	6	4	46.0	54	...	...	...	19.7
Total . . .	1	450.8	15	36	619.5	33	13	326.9	25	34	896.1	23	134	1 016.6	81	...	...	...	

Number of train-miles: 34 176 000.

Number of fractures { total: 226. per 10 000 000 tr.-km. or 6 250 000 train-miles: 41.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails* . . .	57 %	43 %	No data.				
Medium rails . .	90 %	10 %					

		RAILS: *Light rails.*	*Medium rails.*	*Heavy rails.*
E. a) New clean fractures	with internal transverse fissure	2	...	Not used.
	without internal transverse fissure	32	20	
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	36	23	
	in the head	15	20	
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	15	37	
d) Number of pieces rails are broken into	2 pieces	81 %	...	
	3 pieces	16 %	...	
	4 pieces	3 %	...	

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
COLONIES.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
State Railways in the Dutch Indies.																			
A. Rails outside tunnels. *Light*	...	115.0	...	...	420.0	...	1	247.3	2.51	1	671.0	1.08	34	1 385.7	15.45	36	2 839.1	7.88	Steam tr.: 11.8 Elect. tr.: 13.8
B. Rails in tunnels. *Light*	...	...	...	...	1.2	...	...	0.6	...	...	0.6	...	3	2.5	750	3	4.9	375	
C. The whole of A and B. *Light*	...	...	...	...	421.2	...	1	247.9	2.51	1	671.6	1.08	37	1 388.2	16.56	39	2 844.0	8.52	

Number of train-miles: 16 591 000.

Number of English ton-miles: 1 735 630 000.

Number of fractures: total: 39.
per 10 000 000 tr.-km. or 6 250 000 train-miles: 14.6.
per 1 billion tkm. or 612 000 000 English ton-miles: 13.8.

	Percentage of fractures in the part: covered by the fishplates	Percentage of fractures in the part: clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	on curves of ⩽ 800 m. (40 chains) radius: Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	on a rising or falling gradient: > 10 mm. per m. (1 in 100)
D *Light rails.*	7.7 %	92.3 %	21	10	8	34	5
	Miles of single track of each class.		2 407.8	436.2		2 343.2	500.8

		Light rails
E. a) New clean fractures	with internal transverse fissure	1
	without internal transverse fissure	18
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	23
	in the head	3
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	7
d) Number of pieces rails are broken into	not completely severed	15
	2 pieces	23
	3 pieces	1

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			The whole of the rails.			*Maximum axle load.*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Dutch Indies Railway Company.		Miles.			Miles			Miles.			Miles.			Miles			Miles.		English tons.
A. Rails outside tunnels.																			
Light rails.																			
51.8 lb. D/M	...	...	...	...	...	...	...	...	...	...	...	...	...	21.1	...	...	21.1	...	
51.8 lb. G/S	...	...	...	...	...	...	...	...	...	...	...	...	1	105.0	6	1	105.0	6	
56 lb.	...	...	...	...	...	...	...	...	...	...	...	...	...	64.6	...	...	64.6	...	
60.1 lb	...	...	...	...	...	...	...	26.1	...	...	...	...	...	...	...	...	26.1	...	
67.5 lb	...	...	...	...	...	...	...	...	...	...	...	...	...	117.4	...	...	117.4	...	12.2
75 lb.	...	...	...	...	...	...	...	...	...	...	42.9	...	...	...	...	...	42.9	...	
76.6 lb	...	42.3	...	...	37.3	...	...	74.0	...	...	...	...	...	...	...	...	153.6	...	
82.7 lb	...	...	...	...	...	...	...	...	...	...	11.8	...	...	...	...	...	11.8	...	
Total	...	42.3	...	...	37.3	...	...	100.1	...	...	54.7	...	...	308.1	2	1	542.5	1.14	

Number of train-miles : 2 945 040.

Number of English ton-miles : 111 928 000.

Number of fractures { total : 1.
per 10 000 000 tr.-km. or 6 250 000 train-miles : 2.
per 1 billion tkm. or 612 000 000 English ton-miles : 5.46.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES : on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails*	...	100	...	...	1	...	...
	Miles of single track of each class.		51 lb. G/S = 105 mil.	...	...	...	...

	Light rails.
E. *a*) New clean fractures { with internal transverse fissure	1
without internal transverse fissure	...
d) Number of pieces rails are broken into	2

Note. — The fracture occurred at km. 37.365 of the Solo-Batoeretno line, in a rail from the old track of the Goendih-Soerabaya line (new line section inserted about 1923).

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
PORTUGAL.																			
Colonies.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
a) **Lourenço-Marquès Railway.**																			
A Rails outside tunnels. *Light*	...	...	...	...	...	...	...	...	...	...	...	...	4	253.2	9	4	253.2	9	14.8
b) **Inhambane Railway.**																			
B. Rails outside tunnels. *Light*	...	...	...	...	...	...	...	...	...	45	16.2	1737	...	41.0	...	45	57.2	489	...
c) **Quelimane Railway.**																			
C. Rails outside tunnels. *Light*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21.7	...	12.3
Medium	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	68.4	...	

Number of train-miles { *a*) L. M. Ry.: 363 430. *b*) Inh. Ry.: 31 045.
Number of English ton-miles *a*) L. M. Ry.: 140 294 400.

Number of fractures (for L. M. Ry.) { total: 4. per 10 000 000 tr.-km. or 6 250 000 train-miles: 68. per 1 billion tkm. or 612 000 000 English ton-miles: 17.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ≤ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ≤ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails.*							
a) Lourenço-Marquès Ry.	75 %	25 %	4	...	...	...	...
b) Inhambane Ry.	...	...	1.7	...	...	...	...

		Light rails. *a*) Lourenço-Marquès Ry.	*b*) Inhambane Ry.
E. *a*) New clean fractures	with internal transverse fissure	1	...
	without internal transverse fissure	...	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the head	...	...
	in the foot	...	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	...	45

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
RUMANIA. State Railways.																			
A. Rails outside tunnels *Light*	13	810.8	10	12	329.5	22.6	21	275.0	47.5	42	1 350.5	19.3	1006	3 487.5	179.2	1094	6 253.3	108.8	17.7
Medium.	12	300.4	24.9	3	43.1	43.4	1	23.8	26.1	1	25.9	24	...	472.9	...	17	866.1	12.2	19.7
Total . . .	25	1 111.2	14	15	372.6	25.1	22	298.8	45.7	43	1 376.4	19.5	1006	3 960.4	157.8	1111	7 119.4	97.2	

Number of train-miles : 32 411 923.

Number of English ton-miles : 2 633 209 100.

Number of fractures { total : 1 111. per 10 000 000 tr.-km. or 6 250 000 train-miles : 213. per 1 billion tkm. or 612 000 000 English ton-miles : 258.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES : on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Light rails* . . .	20.3 %	79.8 %	747	181	167	946	148
Medium rails . .	29.4 %	70.6 %	9	4	4	6	11
		Total . . .	756	185	171	952	159

E. *a*), *b*) and *c*). — No records.

d) Number of pieces rails are broken into		*Light rails.*	*Medium rails.*
	2 pieces	1 084	17
	3 pieces	8	...
	4 pieces	1	...
	10 pieces	1	...

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SWEDEN. Stockholm-Västeras-Bergslagen. Railway.											Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light* .	...	...	...	...	...	...	...	...	...	...	...	...	4	271.5	9.1	4	271.5	9.1	7.8
A. Rails outside tunnels. *Medium*	...	...	...	...	...	...	...	...	...	...	26.7	...	...	...	...	...	26.7	...	...
Total . . .	...	...	...	...	...	...	...	...	...	...	26.7	...	4	271.5	9.1	4	298.2	8.3	

Number of train-miles: 1 353 875.

Number of English ton-miles: 42 587 500.

Number of fractures { total: 4.
per 10 000 000 tr.-km. or 6 250 000 train-miles: 18.3.
per 1 billion tkm. or 612 000 000 English ton-miles: 57.7.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m (1 in 100)
D. *Light rails* . . .	...	100 %	3	1	...	3	1
D. *Medium rails* . .	..	...	...	...	...	...	...

E.		*Light rails.*	*Medium rails.*
a) New clean fractures		2	...
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	...	...
	in the head	2	...
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head . . .	in the web	...	...

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS: Less than 5 years.			5 to 10 years.			10 to 15 years.			15 to 20 years.			More than 20 years.			The whole of the rails.			*Maximum axle load.*
	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CZECHOSLOVAKIA. State Railways.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light*	5	539.3	5.8	19	420.0	28.1	42	326.1	80.0	78	1 004.1	48.3	819	4 979 3	102.2	963	7 268.8	82.3	
Medium	14	744.5	11.7	13	568.7	14.2	15	212.1	44.0	34	408.7	51.7	96	656.0	90.9	172	2 590.0	41.3	
Total	19	1 283.8	9.2	32	988.7	20.1	57	538.2	65.8	112	1 412.8	49.3	915	5 635.3	100.9	1135	9 858.8	71.5	
B. Rails in tunnels. *Light*	...	6.1	...	1	2.5	252.1	1	2.7	228.6	...	2.5	...	...	4.4	...	2	18.2	68.3	
Medium	...	6.1	...	...	2.7	...	1	.7	824.4	...	1.4	...	...	2.4	...	1	13.3	46.3	
Total	...	12.2	...	1	5.2	120.8	2	3.4	357.9	...	3.9	...	...	6.8	...	3	31.5	58.9	
C. The whole of A and B *Light*	5	545.4	5.7	20	422.5	29.4	43	328.8	81.2	78	1 006.6	48.2	819	4 983.7	102.1	965	7 287.0	82.3	12.8 to 15.8
Medium	14	750.6	11.6	13	571.4	14.1	16	212.8	46.7	34	410.1	51.5	96	658.4	90.6	173	2 603.3	41.3	16.8
Total	19	1 296.0	9.1	33	993.9	20.6	59	541.6	67.7	112	1 416.7	49.1	915	5 642.1	100.8	1138	9 890.3	71.5	

Number of train-miles: 71 871 500.

Number of English ton-miles: 20 260 113 700.

Number of fractures { total: 1 138. per 10 000 000 tr.-km. or 6 250 000 train-miles: 98.4. per 1 billion tkm. or 612 000 000 English ton-miles: 34.4.

	Percentage of fractures in the part: covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES: on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius: Lower rail.	Higher rail.	on a rising or falling gradient: ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D. *Medium rails*	44.3 %	55.7 %	550	246	169	761	204
Light rails	62.3 %	37.7 %	137	23	13	171	2
		Total	687	269	182	932	206
		Miles of single track of each class.	6 150.3	3 740.0		7 033.8	2 856.5

		Light rails.	*Medium rails.*
E. a) New clean fractures	with internal transverse fissure	195	28
	without internal transverse fissure	199	32
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the foot	178	36
	in the head	241	55
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	152	22

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	Length of single track of this class.	Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TURKEY. State Railways.		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
A. Rails outside tunnels. *Light* .	...	431.8	...	1	477.2	1.30	...	62.1	...	1	62.1	10	9	603.4	9.26	11	1 279.6	5.34	16.7
Medium.	...	...	...	...	...	...	...	14.3	...	...	...	...	...	...	...	...	14.3	...	...
Total . . .	...	431.8	...	1	477.2	1.30	...	76.4	...	1	62.1	10	9	603.4	9.26	11	1 293.9	5 28	

	Percentage of fractures in the part covered by the fishplates	clear of the fishplates	NUMBER OF FRACTURES : on straight lines or curves of > 800 m. (40 chains) radius	on curves of ⩽ 800 m. (40 chains) radius Lower rail.	Higher rail.	on a rising or falling gradient ⩽ 10 mm. per m. (1 in 100)	> 10 mm. per m. (1 in 100)
D *Light rails.* .	...	100	7	4	...	11	...

	Light rails.
E. *a)* New clean fractures	5
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head . . . . in the foot	3
in the head	3

NAMES OF ADMINISTRATIONS AND DESCRIPTION OF RAILS.	AGE OF RAILS : Less than 5 years. Number of fractures.	Less than 5 years. Length of single track of this class.	Less than 5 years. Number of fractures per 1 000 km. or per 625 miles.	5 to 10 years. Number of fractures.	5 to 10 years. Length of single track of this class.	5 to 10 years. Number of fractures per 1 000 km. or per 625 miles.	10 to 15 years. Number of fractures.	10 to 15 years. Length of single track of this class.	10 to 15 years. Number of fractures per 1 000 km. or per 625 miles.	15 to 20 years. Number of fractures.	15 to 20 years. Length of single track of this class.	15 to 20 years. Number of fractures per 1 000 km. or per 625 miles.	More than 20 years. Number of fractures.	More than 20 years. Length of single track of this class.	More than 20 years. Number of fractures per 1 000 km. or per 625 miles.	The whole of the rails. Number of fractures.	The whole of the rails. Length of single track of this class.	The whole of the rails. Number of fractures per 1 000 km. or per 625 miles.	*Maximum axle load.*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
URUGUAY. Central Uruguay Railway and Associated Companies (Year 1930.) *Light rails.*		Miles.			Miles.			Miles.			Miles.			Miles.			Miles.		English tons.
60.5 lb. per yard	...	...	...	...	...	...	...	...	...	...	...	...	4	35.4	70	4	35.4	70	...
65 lb. per yard	...	...	...	...	...	...	...	...	...	...	...	...	23	687.9	21	23	687.9	21	...
80 lb. per yard	...	111.7	...	...	46 0	...	...	...	...	...	70.3	...	5	42.2	74	5	270.2	11.4	...
Total	...	111.7	...	...	46.0	...	...	...	...	...	70.3	...	32	765.5	26	32	993.5	20	

Number of train-miles: 2 816 290.

Number of fractures { total: 32. per 10 000 000 tr.-km. or 6 250 000 train-miles: 70.

	Number of fractures in the part of the rail: Covered by the fishplates.	Clear of the fishplates.
D. *Light rails*	10	18

		Light rails.
E. *a*) New clean fractures	without internal transverse fissure	...
	with internal transverse fissure	10
b) Fractures with much rusted old part, extending to the outer surface of the foot or the head	in the head	11
	in the foot	2
c) Fractures with much rusted old part, *not* extending to the outer surface of the foot or the head	in the web	1
d) Number of pieces rails are broken into		Generally 2

NEW BOOKS AND PUBLICATIONS.

[313 : 385 (.44)]

GODFERNAUX (R.), Engineer, Member of the Committee for Public Works in the Colonies, France; Director of the *Revue Générale des Chemins de fer*. — **Les Grands Réseaux de Chemins de fer français, année 1932 (The Main Line French Railways, 1932).** — A pocket book (4 1/2 × 6 3/4 inches) of 40 pages. — 1933, Paris, Dunod, 92, rue Bonaparte. (Price : 5 French francs.)

For several years, the author has published regularly, in pamphlet form, a certain number of statistical tables in which he has condensed the essential information needed to appreciate the volume of business and the present situation of the French main line railways.

This time, he briefly indicates, in his introduction, the principles on which the present regimen, based on the 1921 convention, is founded (he described the features of this convention in his review of 1931). Its essential characteristics lie in the introduction of a certain community of interest between the main line railways, which becomes concrete financially in the « common fund ». It is built up on the principle of the obligatory equilibrium between expenditure and receipts, generally by means of alterations in the rates for this purpose, whenever necessary, and, in case of need, by loans from the Treasury.

The author has found it useful to recall these facts in order to bring out the full significance of the facts he has brought forward, and the reflections he has made in his note entiled : *General aspect of the year 1932, and forecast for 1933.*

The deficit of the French railways is attribued to the economic crisis, to road motor competition, and to other causes more special to France. The author quotes and comments upon the measures taken or proposed by the Public Authorities (which he considers insufficient), and calls to mind the general programme drawn up by the Companies, a programme leading to the reorganisation of transports, and the realisation of the financial equilibrium of the railways. He stresses the efforts of the railways who are practising a strict policy of economy, reducing by degrees the number of their staff, and improving to a considerable extent the efficiency of the personnel. He finally supports the general measures proposed by the railways to make good their deficit, at the same refusing to have anything to do with any formulæ involving nationalisation.

E. M.

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[656]

WAIS (Francisco), Engineer, North of Spain Railway Company. — **Explotación técnica de Ferrocarriles (Technical operation of railways).** — One volume (7 1/2 × 5 1/8 inches), of 515 pages, with 284 illustrations. — 1933, Barcelona, Editorial Labor, S. A., Calle Provenza, 86-88.

The author states that his object, in writing this book, was to present a work of an elementary character, intended for those who wish to be initiated into the operation of railways, and for those who want to acquire supplementary knowledge while carrying out their profession. The initiated, he says, will not find anything very new in this work of a popular character.

This will be understood when one observes the extensive scope of the book, which includes in the first part : the track, the rolling stock, the locomotives, electric traction, stations, shunting yards, signals, interlockings, and in the second part : the trains, the utilisation of the rolling stock, train working, the block system, telegraph and telephone, dispatching system, operating methods, and centralised traffic control.

Nonetheless, the author has underestimated the value of his work, as, if he has dealt in the different chapters with the most important subjects, he has also described, when deemed useful, the scientific or technical developments on which are based the design of the equipment or rolling stock.

On the other hand, he is clearly of the time in which he is writing, a time of depression for the railways and a time of transformation. In the course of the book, one comes across many innovations likely to improve the railway service and to effect working savings. Without mentioning investigations into the co-ordination of the various means of transportation, we may quote : new types of light trains, often consisting of rail motor coaches, some of which are running on pneumatic tyres, the suppression or decrease in number of hand-operated signals, circulation or rail motor coaches by sight, regulation of train running by an employee using special telephone circuits (dispatcher), the increased duties of the train staff with a reduction in the number of the station staff, the reorganisation of the station services, and finally, in a general way, the rationalisation and scientific organisation of the work, necessary today in every industry.

[385. (02]

The Universal Directory of Railway Officials and Railway Year Book, 1933-34. — 1933, London : The Directory Publishing Co., Ltd., 33, Tothill Street, Westminster, S. W. 1. (Price : 20 s. net.)

This is a new railway annual, combining the most useful features of *The Universal Directory of Railway Officials* and *The Railway Year Book* and giving additional information. The comprehensive lists of officials of railways throughout the world, together with particulars of the length, gauge and equipment and locomotives and rolling-stock, duly brought up-to-date, are retained from the familiar *Universal Directory*. Much tabular matter, duly revised to date, and other useful information concerning individual systems and railways generally have been incorporated from *The Railway Year Book,* while an amount of new material, consisting largely of comprehensive statistical and financial details relating to the British railways, has been added. Perhaps the two most important features in the present volume, to the student, are the brief general descriptions, with the latest financial results, of all the chief railway systems of the World, and the information given concerning Governmental and other authorities exercising control over railways. The new annual can certainly be said to form a valuable and up-to-date railway encyclopedia such as has never previously been presented to the railway world or the public.

[385. (09. 2]

OBITUARY.

YOUSSEF RISGALLAH BEY,

Former Assistant General Manager of the Egyptian State Railways,
Member of the Board of Management of the State Railways Administration,
Member of the Permanent Commission of the International Railway Congress Association.

We have learnt with deep regret of the death, on the 15th August last, at Vichy, of His Excellency Youssef Risgallah Bey, a former assistant General Manager of the Egyptian State Railways, member of the Board of Management of the State Railways Administration and member of the Permanent Commission of the Railway Congress Association. The deceased, an eminent personality on the Egyptian Railways, took a very active part in the organisation and the work of the Cairo Congress.

Born in 1877, at Alexandria, he obtained his primary and secondary education at the Christian Brothers' Institute in that city. He matriculated before he was 15 years old, with special mention : he had a perfect knowledge of the Arab, French, English, Italian and Greek languages. At the age of 16, he entered the General Manager's office of the Egyptian State Railways as French correspondence clerk; as a result of the exceptional ability he displayed, he was sent to Europe to complete his higher studies in France, England and Belgium.

He visited and studied the railways of each of these countries, and then returned to Egypt, where he was employed at a number of the main stations of the system. He remained several years at Gabbary, the most important station, and throughout the Great War he organised the embarkation and disembarkation of troups and war material. His excellent service was rewarded by his being brought back to Cairo to fill the post of General Rolling Stock Controller. His duty was to cooperate in the after-war reorganisation of the operating services, which he carried out with the greatest success.

He was in consequence promoted Assistant Traffic Manager, and subsequently Assistant Goods Manager. His Excellency Abdul Hamid Pasha Soliman, when appointed General Manager of the Railways in 1924, appointed him to the important position of General Secretary of the State Railways, Posts, Telegraphs and Telephones, in which he still further distinguished himself. He was later made Assistant General Manager of the said Administration.

Whilst holding this position, he developed important schemes of improvement and reorganisation.

When about to retire, although he had not reached the superannuation age, he acceeded to the insistance of the Egyptian Government and accepted the duties of Member of the Board of Management of the State Railways.

In addition, the great Egyptian Insur-

ance Company « El Chark » persuaded him to accept the position of Controller General; he was justly called the soul of this Company.

In view of his technical and administrative experience, he was made General Secretary of the International Navigation Congress, which was held in Cairo some years ago and, in recognition of his valuable assistance at that Congress, he was also appointed General Secretary of the XIIth Session of the International Railway Congress, which was held in Cairo in January 1933. His energy and organising ability were the admiration of all the Egyptian and foreign delegates and, in recognition of his eminent services, the International Congress Association made him a member of its Permanent Commission.

As member of the Permanent Commission, he represented the Egyptian Government at the meeting held on July 29th, 1933. He was soon afterwards taking a holiday at Vichy when his death suddenly occurred.

He held the following decorations :

Commander of the Order of Ismail;
Knight of the Order of the Nile;
Officer of the Legion of Honour;
Commander of the Order of Leopold II.

We offer his family our sincerest sympathy in their bereavement.

The Executive Committee.

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P. GHILAIN,

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Véhicules roulants de chemin de fer. Théorie mécanique du mouvement oscillatoire des ressorts.

Bruxelles, Bieleveld, A., 66, rue Montagne-aux-Herbes-Potagères. 1 volume (16 × 24 cm.), 76 pages. (Prix: francs belges).

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In German.

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Der Eisenbetonbau.

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Berechnung gegliederter Knickstäbe.
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Report on the present state of road and rail competition and the possibilities of their future co-ordination and development, and cognate matters, in Governors' provinces.

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Machine tool work. Fundamental principles.

New York and London. McGraw-Hill Book Co, (6 × 9 inches), 424 pages, illust., diagr., charts, tables. (Price : $ 3.00.)

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La Compagnie d'Orléans en 1932. (4 500 mots.)

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KLEIN (A.). — La **résistance** des constructions aux mouvements vibratoires. (5 700 mots & fig.) (Suite et fin.)

1933 **656 .212.6**
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Le **transport des marchandises** avec séparation des éléments de roulement et de chargement. (2 200 mots et fig.)

1933 **621 .132.8**
Génie civil, n° 2645, 22 avril, p. 377.
Locomotive à vapeur articulée, à grande puissance, système Franco. (1 900 mots et fig.)

1933 **62. (01 & 721 .9**
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L'HERMITE (R.). — Calcul des parois planes et des poutres-cloisons en **béton armé.** (3 800 mots et fig.)

1933 **621 .43**
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La détonation dans les **moteurs Diesel.** (1 800 mots.)

1933 **669**
Génie civil, n° 2646, 29 avril, p. 402.
Le dosage de l'oxygène et des oxydes dans le **fer** et **l'acier.** (1 600 mots & fig.)

1933 **698**
Génie Civil, n° 2647, 6 mai, p. 428.
CHAUDY (F.). — L'adhérence des **peintures** sur les constructions métalliques. (800 mots & fig.)

1933 **626 (.493)**
Génie civil, n° 2648, 13 mai, p. 437.
BIJLS (A.). — Le **canal** Albert, voie de grande navigation intérieure de Liége à Anvers. (5 500 mots et fig.)

1933 **669 .1**
Génie civil, n° 2648, 13 mai, p. 453.
PERRIN (R.) & PORTEVIN (A.). — L'évolution des inclusions dans l'élaboration des **aciers.** (900 mots.)

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1933 **621 .132 .1 (.44**
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1933 **625 .15 & 669 .**
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SPIESS (E.). — **Acier spécial** pour voie et appareil de voie. (5 400 mots & fig.)

1933 **621 .132.3 (.43**
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Locomotives Pacific des chemins de fer de l'Eta allemand. (1 600 mots.)

1933 **625 .21**
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Roues élastiques pour voie ferrée. (5 300 mots & fig.

1933 **621 .9**
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L'écrou-fraise indesserrable Isothermos. (1 600 mot & fig.)

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CHARRIN (W.). — Les **huiles combustibles.** (1 80 mots.)

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1933 **621 .43 (.44)**
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Note sur l'utilisation des **automotrices** sur la Compagnie de chemins de fer secondaires pendant la période de 1907 à 1932. (800 mots, 2 tableaux & fig.)

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1933 **656 .212.9 (.494)**
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Das neue **Bahnhofkühlhaus** in Basel. (2 000 Wörter & Abb.)

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LÉVI (R.). — **Agrandissements et aménagements** de la **gare** de Versailles-Chantiers. (3 500 mots & fig.)

1933 **625 .23 (.44) & 625 .213 (.44)**
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VALLANCIEN (J.). — La **suspension** du bogie Y2, pour voitures à voyageurs. (10 500 mots & fig.)

1933 **385. (09 (.495) & 385 .113 (.495)**
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Rapport sur la **situation** des chemins de fer en Grèce en 1932. (7 300 mots.)

1933 **385. (06 .111**
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Compte rendu des séances de la 12e Session du Congrès international des chemins de fer. (Le Caire 1933.) (15 300 mots.)

1933 **385 .113 (.438)**
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Chemins de fer de Pologne. (5 000 mots & carte.)

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1933 **385 (.3)**
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La **situation** des chemins de fer à l'étranger et en France. (22 000 mots). (*A suivre.*)

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REPRIELS (L.). — La **semaine de quarante heures.** La Conférence du Travail de janvier 1933, à Genève. (13 600 mots.)

1933 **624 .2**
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1933 **385 (.73)**
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Bericht über die Ausführung des Programms zur **Verbesserung** der rumänischen Bahnen im 2. und 3. Anwendungsjahr. (3 700 Wörter.)

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Die Lokomotive. (Wien.)

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STEFFAN. — Neuer Austro Daimler-**Schnelltriebwagen.** (4 700 Wörter & Abb.)

1933 **656 .222.1**
Die Lokomotive, Mai, S. 93.

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1933 **621 .135.4 & 625 .215**
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LIECHTY (R.). — Das gleitende **Flügelrad.** (3 000 Wörter & Abb.)

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1933 **625 .14 (01**
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JANICSEK (J.). — Zur Frage der einheitlichen Berechnung des **Eisenbahnoberbaues.** (4 200 Wörter, 9 Tabellen & Abb.)

1933 **625 .14 (01**
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1933 **625 .14 (01**
Organ für die Fortschritte des Eisenbahnwesens, Heft 9, 1. Mai, S. 189.
ROSTECK. — **Federoberbau auf Brücken ?** (2 900 Wörter, 2 Tabellen & Abb.)

1933 **385. (06.112**
Organ für die Fortschritte des Eisenbahnwesens, Heft 10, 15. Mai, S. 197.
STUDENT. — Internationaler **Eisenbahnkongress**, Kairo 1933. (5 000 Wörter.)

1933 **625 .13 (.43) & 625 .245 (.43)**
Organ für die Fortschritte des Eisenbahnwesens, Heft 10, 15. Mai, S. 202.
BAUMANN (H.). — Neuer **Tunneluntersuchungswagen** der Reichsbahndirektion Karlsruhe. (3 000 Wörter & Abb.)

1933 **625 .233 (.43)**
Organ für die Fortschritte des Eisenbahnwesens, Heft 10, 15. Mai, S. 207.
KNORR. — Die **elektrische Beleuchtung** der Nebenbahnzüge im Bereich der Gruppenverwaltung Bayern der D. R. G. (3 100 Wörter & Abb.)

Zeitschrift des Vereines Deutscher Ingenieure. (Berlin.)

1933 **621 .335 (.439)**
Zeitschr. des Ver. deutsch. Ing., Nr. 16, 22. April, S. 415.
DOMINKE (H.). — Die **Umformerlokomotiven** der Ungarischen Staatsbahnen. Der elektrische Betrieb auf der Strecke Budapest-Hegyeshalom. (4 700 Wörter, 4 Tafeln & Abb.)

1933 **621 .91**
Zeitschr. des Ver. deutsch. Ing., Nr. 16, 22. April, S. 423.
SIPMANN (F.) & SCHLEGELMILCH. — Grosse vereinigte **Hobel- und Fräsmaschine.** (1 400 Wörter & Abb.)

1933 **69**
Zeitschr. des Ver. deutsch. Ing., Nr. 17, 29. April, S. 433.
RAUSCH (E.). — Einwirkung von Windstössen auf hohe **Bauwerke.** (3 300 Wörter & 2 Tafeln.)

1933 **62. (01 & 621 .392**
Zeitschr. des Ver. deutsch. Ing., Nr. 19, 13. Mai, S. 493.
THUM (A.) & SCHICK (W.). — Dauerfestigkeit von **Schweissverbindungen** bei verschiedener Formgebung. (2 400 Wörter & Abb.)

1933 **621 .83**
Zeitschr. des Ver. deutsch. Ing., Nr. 19, 13. Mai, S. 499.
WITTE (Fr.) & STAMM (O.). — Das **Zadowgetriebe.** (3 000 Wörter & Abb.)

1933 **621 .9**
Zeitschr. des Ver. deutsch. Ing., Nr. 18, 6. Mai, S. 469
KÜHNER (O.). — Über **Ziehpressen.** (5 200 Wörter & Abb.)

1933 **621 .392**
Zeitschr. des Ver. deutsch. Ing., Nr. 18, 6. Mai, S. 475
BLOMBERG (H.). — Der Einfluss von Schlackeneinschlüssen auf die Güte der Schweissnaht bei der **elektrischen Widerstands - Stumpfschweissung.** (1 500 Wörter & Abb.)

1933 **621 .131.3**
Zeitschr. des Ver. deutsch. Ing., Nr. 18, 6. Mai, S. 481
NORDMANN (H.). — Die Mechanik der **Zugförderung.** Entwicklung und neue Versuchsergebnisse. (2 800 Wörter & Abb.)

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen. (Berlin.)

1933 **656 .254 (.43)**
Zeitschr. für das gesamte Eisenbahn-Sicherungswesen, Nr. 6, 1. Mai, S. 61.
RUSTENBECK. — **Selbsttätige Warnlichtanlage** für zwei benachbarte Wegübergänge der Streke Liegnitz-Raudten. (2 700 Wörter & Abb.)

1933 **656 .257**
Zeitschr. für das gesamte Eisenbahn-Sicherungswesen, Nr. 6, 1. Mai, S. 69.
WAGNER (Th.). — Neuzeitliche Entwicklung der **Ablaufstellwerke.** (1 500 Wörter & Abb.) (Fortsetzung folgt.)

Zeitung des Vereins Mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

1933 **656 .23 (0 (.43)**
Zeitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 16, 20. April, S. 329.
VOGT. — Die **Beeinflussung des internationalen Verkehrs** durch die Tarif- und Verkehrspolitik der Reichsbahn. (6 500 Wörter, 2 Tabellen & Abb.)

1933 **621 .135.2 (.73) & 625 .212 (.73)**
Zeitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 16, 20. April, S. 337.
SCHWERING (F.). — **Hartgussräder** im nord-amerikanischen Eisenbahnbetrieb. (4 600 Wörter & Abb.)

1933 **656 .237**
Zeitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 17, 27. April, S. 349.
GEHR. — **Rechnungsprüfung.** (1 800 Wörter.)

1933 **385 (06 & 625 .245 (06**
Zeitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 17, 27. April, S. 351.
Internationales **Behälterbüro.** (900 Wörter.)

1933 656 .224 (.43)
eitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 18, 4 Mai, S. 369.
WISKOTT. — **Verdichtung und Beschleunigung des ersonenzugverkehrs im Ruhrbezirk.** (2 600 Wörter Abb.)

1933 625 .245 & 656 .225
eitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 18, 4. Mai, S. 374.
BÄSELER. — **Behältersysteme.** (2 300 Wörter.)

1933 656 .225 (.489)
eitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 19, 11. Mai, p. 400.
PASZKOWSKI. — **Rationalisierung des Stückgut-erkehrs in Dänemark.** (2 100 Wörter.)

In English.

Indian Railway Gazette. (London.)

1933 625 .17 (.44)
ndian Railway Gazette, April, p. 16.
STRAUSS (F.). — **The Northern Railway of France.** 2 700 words.)

1933 385 .111 (.931) & 656 .1 (.931)
ndian Railway Gazette, April, p. 74.
Modern railway practice and development. (2 400 ords.)

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1933 621 .18
ournal, Instit. of Engineers, Australia, March, p. 86.
BROWNE (A. R.). — **The generation and utilization f steam in industrial plants.** (10 000 words.)

1933 621 .34 & 621 .39
ournal, Instit. of Engineers, Australia, March, p. 104.
STEELE (C. L.). — **The remote supervision of elec-rical power equipment.** (4 500 words & fig.)

Journal, Institute of Transport. (London.)

1933 621 .33 & 656 .1
ournal, Institute of Transport, May, p. 382.
SPENCER (C. J.). — **Electric trolley omnibuses.** 14 000 words.)

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1933 621 .98 (.42)
Engineer, No. 4031, April 14, p. 373.
A twist drill grinder. (900 words & fig.)

1933 65
Engineer, No. 4031, April 14, p. 379.
TRIPP (G. W.). — **Organising the Stores Depart-nent.** (4 100 words.)

1933 621 .135.3 & 621 .335
Engineer, No. 4031, April 14, p. 380.
BAXTER (F. L.). — **High-speed electric locomotive suspension.** (1 500 words & fig.)

1933 621 .131.2 (.71)
Engineer, No. 4031, April 14, p. 385.
Wind tunnel tests of locomotive models. (2 900 words & fig.)

1933 621 .392
Engineer, No. 4031, April 14, p. 409.
LILLICRAP (C. S.). — **Electric arc welding in war-ship construction.** (3 500 words & tables.)

1933 621 .13 (09
Engineer, No. 4033, April 28, p. 416.
INGLIS (C. E.). — **Trevithick Memorial lecture.** (6 400 words & fig.)

1933 621 .132.1 (.42) & 621 .134.1 (.42)
Engineer, No. 4033, April 28, p. 421.
BREVER (F. W.). — **The L. M. S. compounds.** (3 400 words & fig.)

1933 621 .33 (.489)
Engineer, No. 4033, April 28, p. 432.
Danish State Railway electrification (1 100 words & fig.)

1933 621 .13 (09
Engineer, No. 4034, May 5, p. 442.
INGLIS (C. E.). — **Trevithick Memorial lecture.** (5 900 words & fig.)

1933 621 .131.2 & 656 .221
Engineer, No. 4034, May 5, p. 453.
The air resistance of locomotives. (2 000 words.)

1933 62 .01 & 656 .28 (01
Engineer, No. 4034, May 5, pp. 449 & 459.
The **mechanical breakdown of prime movers and boiler plant.** Abstract of a Paper read by Mr. L. W. SCHUSTER on Friday 28 April 1933 at the Institution of Mechanical Engineers. (10 000 words, tables & fig.)

1933 669 .1 (06 (.42)
Engineer, No. 4035, May 12, p. 471.
The Iron and Steel Institute. **Annual Meeting** held on 4 and 5 May 1933.

1933 621 .13 & 656 .222
Engineer, No. 4035, May 12, p. 479.
Locomotives and trains. (1 900 words.)

1933 669
Engineer, No. 4035, May 12, p. 480.
Quenching and tempering of alloys. (4 700 words.)

1933 621 .133.1 & 621 .43
Engineer, No. 4035, May 12, p. 482.
The ignition quality of engine fuels. (2 500 words & fig.)

Engineering. (London.)

1933 621 .9 (06.1 (.42)
Engineering, No. 3509, April 14, p. 400.
Machine tools at the **Leipzig Fair.** (3 400 words & fig.)

1933 621 .33 (.44) & 625 .4 (.44)
Engineering, No. 3510, April 21, p. 428.
RICH (Th.). — The **development** of the **Paris Metropolitan Railway.** (3 000 words & fig.)

1933 62 (01
Engineering, No. 3510, April 21, p. 432.
Apparatus (Amsler) for **static and dynamic tensile and compression tests.** (2 000 words & fig.)

1933 621 .33 (.485)
Engineering, No. 3510, April 21, p. 449.
The **economic problems** of the **Swedish State Railway electrification.** (1 500 words & map)

1933 621 .43
Engineering, No. 3512, April 28, p. 454.
HEAP (A. C.). — The **reliability and economy** of the **Diesel-engined locomotive and rail coach.** (4 900 words & 2 tables.)

1933 621 .13 (09
Engineering, No. 3511, April 28, p. 459.
The **Trevithick Memorial lecture.** (1 600 words.)

1933 621 .43
Engineering, No. 3511, April 28, p. 467.
Heavy-oil shunting locomotives. (600 words.)

1933 621 .33 (.489)
Engineering, No. 3511, April 28, p. 476.
Suburban electric traction at Copenhagen. (1 000 words & fig.)

1933 537 .9 (.43) & 621 .392 (.43)
Engineering, No. 3512, May 5, p. 479.
BONDY (O.). — **German conventional symbols for welding.** (2 100 words & fig.)

1933 62. (01 & 656 .28 (01
Engineering, No. 3512, May 5, pp. 488 and 496.
The investigation of the **mechanical breakdown** of **prime movers and boiler plant.** Abstract of a Paper read by Mr. L. W. SCHUSTER at the Institution of Mechanical Engineers on Friday 28 April 1933. (8 000 words & fig.)

1933 624 .62 (.489)
Engineering, No. 3512, May 5, p. 497.
Combined highway and railway bridges across Storström and Masnedsund. (900 words & fig.)

1933 621 .9 & 621 .
Engineering, No. 3512, May 5, p. 504.
High-duty **spot-welding machines.** (1 200 words fig.)

1933 62. (
Engineering, No. 3512, May 5, p. 505.
125-kgr. **hardness-testing machine.** (600 words fig.)

1933 621 .132.8 (.8
Engineering, No. 3513, May 12, p. 517.
Henschel **condensing locomotive** on the Argenti State Railways. (900 words & fig.)

1933 669
Engineering, No. 3513, May 12, p. 528.
PORTEVIN (A. M.) & PERRIN (R.). — Cont bution to the study of **inclusions in steels.** (4 4 words & fig.)

Engineering News-Record. (New York.)

1933 6
Engineering News-Record, No. 14, April 6, p. 431.
WOODS (H.), STEINOUR (H. H.) and STARK (H. R.). — **Heat evolved by cement** in relation **strength.** (3 000 words & fig.)

1933 624 .63 (.7
Engineering News-Record, No. 15, April 13, p. 467.
MITCHELL (S.). — A **320-ft. concrete arch** scenic route along California coast. (2 900 words fig.)

1933 624 (.7
Engineering News-Record, No. 17, April 27, p. 531.
Ten years of achievement with **rigid-frame bridge** (800 words & fig.)

The Locomotive. (London.)

1933 621 .134.3 (.4
The Locomotive, April 15, p. 109.
The **Cossart rotary valve gear** (2 400 words & fi

1933 621 .131
The Locomotive, April 15, p. 115.
PHILLIPSON (E. A.). — **Steam locomotive design data and formulæ.** (1 800 words & fig.)

1933 625 .216 (.5
The Locomotive, April 15, p. 123.
WILLIAMS (G.). — **Draw-gear** for Indian bro gauge railways. (2 800 words & fig.)

1933 621 .134.2 (.4
The Locomotive, April 15, p. 132.
Roller bearings for locomotive valve gear. (450 wor & fig.)

1933 621 .43 (.4
The Locomotive, May 15, p. 147.
New Russian **Diesel locomotives.** (650 words & fig

. 1933 621 .133.8 (.42)
The Locomotive, May 15, p. 157.
BREWER (F. W.). — **Locomotive standing arrangements.** Early British methods and recent practice. (1 900 words.)

Mechanical Engineering. (New York.)

1933 62. (01
Mechanical Engineering, May, p. 287.
BITTER (F.). — **Magnetism and the structure of metals.** (1 400 words & fig.)

Modern Transport. (London.)

1933 656 .253 (.42)
Modern Transport, No. 735, April 15, p. 3.
Power signaling on the Southern Railway. (1 700 words & fig.)

1933 625 .24
Modern Transport, No. 735, April 15, p. 6.
High-capacity wagons. (750 words.)

1933 621 .33 (.489)
Modern Transport, No. 736, April 22, p. 3.
Electrification of Danish Railways. (850 words & fig.)

1933 621 .33 & 625 .62
Modern Transport, No. 736, April 22, p. 7.
Evolution of the **trolley omnibus.** (2 000 words.)

1933 656 .253 (.42)
Modern Transport, No. 737, April 29, p. 3.
Resignalling of York-Newcastle main line. Notable L. N. E. R. installation includes **relay interlocking, series-phased track circuits, and approach-lighted automatic signals.** (3 000 words & fig.)

1933 621 .33 (.47)
Modern Transport, No. 737, April 29, p. 5.
Railway electrification in the U. S. S. R. (2 200 words & fig.)

1933
Modern Transport, No. 738, May 6, p. 7; No. 739, May 13, p. 5.
MANCE (Sir H. Osborne). — **Transport control and regulation.** (2 800 words.)

1933 621 .33 (.436)
Modern Transport, No. 739, May 13, p. 9.
STRAUSS (F.).— **Railway electrification** in Austria. (1 200 words & fig.)

Proceedings, American Society of Civil Engineers. (New York.)

1933 624 .32 (.73)
Proc., Amer. Soc. Civil Eng., April, p. 585.
BALLAD (W. T.). — **Three-span continuous-truss railroad bridge,** Cincinnati, Ohio. (7 400 words & fig.)

Proceedings, Institution of Civil Engineers. (London.)

1931-2 621 .89
Proceed, Institut. of Civil Engineers, vol. 233, p. 244.
GOODMAN (John). — An experimental determination of the **distribution and thickness of the oil film in a flooded cylindrical bearing.** (Part. II). (8 600 words & figs.)

1931-2 621 .89
Proceed., Institut. of Civil Engineers, vol. 233, p. 267.
SWIFT (H. W.). — The **stability of lubricating films in journal bearings.** (7 500 words & fig.)

Railway Age. (Philadelphia.).

1933 621 .43 (.43)
Railway Age, No. 14, April 8, p. 503.
German State Railways install **high-speed motor coach.** (1 600 words & fig.)

1933 385 (.73)
Railway Age, No. 14, April 8, p. 509.
Railroad plan nears completion. (6 800 words.)

1933 621 .43 (.73) & 625 .235 (.73)
Railway Age, No. 14, April 8, p. 544.
Power rail car has aluminum body. (2 600 words & fig.)

1933 656 .223.1 & 657
Railway Age, No. 15, April 15, p. 548.
GLACY (G. F.). — Improved **car accounting and statistics** at lower costs. (5 000 words & fig.)

1933 697 (.73)
Railway Age, No. 15, April 15, p. 559.
Use of **unit heaters in shops and enginehouses** has advantages. (2 600 words & fig.)

1933 656 .211.4 (.73) & 725 .31 (.73)
Railway Age, No. 16, April 22, p. 575.
LACHER (W. S.). — Cincinnati's New **Union Terminal** now in service. (12 000 words & fig.)

1933 656 .261 (.73)
Railway Age, No. 16, April 22, p. 595.
Store-door service adopted by Southeastern Railroads. (1 000 words & fig.)

1933 656 .261 (.73)
Railway Age, No. 16, April 22, p. 597.
Pennsylvania and Long Island plan New York **store-door service.** (2 000 words.)

1933 621 .131 .2, 621 .335 & 621 .43
Railway Age, No. 17, April 29, p. 620.
DICKERMAN (W. C.). — **Modern trends in motive power.** (3 800 words & fig.)

1933 625 .143.1 (.73)
Railway Age, No. 17, April 29, p. 627.
Why the 131-lb **R. E. rail section** was adopted. (1 000 words & fig.)

1933 **656 .257 (.7)**
Railway Age, No. 17, April 29, p. 633.
Remote control replaces interlocking on the Wabash.

Railway Engineer. (London.)

1933 **625. (0 (.62)**
Railway Engineer, May, p. 129.
All-metal rolling-stock in Egypt. (900 words).

1933 **625. (0 (.62)**
Railway Engineer, May, p. 134.
KNIGHT (W. D.). — **Steel rolling-stock in Egypt.** (2 700 words.)

1933 **625 .13 (.54)**
Railway Engineer, May, p. 139.
Reconstruction of Kotri bridge, North-Western Railway of India. (1 000 words & fig.)

1933 **621 .132.3 (.54 & 621 .132.5 (.54)**
Railway Engineer, May, p. 141.
New locomotives for India. (1 500 words & fig.)

1933 **625 .253**
Railway Engineer, May, p. 147.
New Westinghouse brake equipment for freight trains. (2 100 words & fig.)

1933 **621 .132.6 (.44)**
Railway Engineer, May, p. 150.
Notable new **2-8-2 tank locomotives,** Northern Railway of France. (3 700 words & fig.)

Railway Engineering and Maintenance. (Chicago.)

1933 **625 .144.4 (.73)**
Railway Engineering & Maintenance, April, p. 182.
Tightening bolts as a system job. (1 900 words & fig.)

1933 **625 .142.2 & 691**
Railway Engineering & Maintenance, April, p. 184.
STIMSON (E.). — Does it pay **to treat timber?** (3 700 words & fig.)

1933 **625 .154 (.73)**
Railway Engineering & Maintenance, April, p. 187.
Innovations feature **renewal of turntable.** (1 200 words & fig.)

1933 **613 .66 (.73) & 642 .2 (.73.)**
Railway Engineering & Maintenance, April, p. 190.
WOOD (J. P.) — Practising **safety in the bridge and building department.** (2 000 words & fig.)

Railway Gazette. (London.)

1933 **625 .3 (.42)**
Railway Gazette, No. 15, April 14, p. 515.
Self-acting inclines. (1 000 words & fig.)

1933 **625 .143.5 (.4**
Railway Gazette, No. 15, April 14, p. 517.
Check and grip rail anchors. (500 words & fig.)

1933 **656 .253 (.4**
Railway Gazette, No. 15, April 14, p. 518.
Colour light signals, Mirfield, L. M. S. R. (1 300 wo & fig.)

1933 **621 .**
Railway Gazette, No. 15, April 14, p. 523.
A new **capstan lathe.** (900 words & fig.)

1933 **656 .2**
Railway Gazette, No. 16, April 21, p. 538.
Automatic train control. (900 words.)

1933 **625 .17 (.4**
Railway Gazette, No. 16, April 21, p. 542.
Permanent way maintenance costs. Interesting d grams indicative of the efficacy of up-to-date ma tenance methods. (700 words & fig.)

1933 **621 .33 (.48**
Railway Gazette, No. 16, April 21, p. 543.
Danish State Railways **electrification.** (1 500 wo & fig.)

1933 **625 .232 (.49**
Railway Gazette, No. 16, April 21, p. 546.
All-steel welded corridor coaches, Netherlands R (850 words & fig.)

1933 **625 .214 (.4**
Railway Gazette, No. 16, April 21, p. 548.
New method of **axlebox and armature lubricati** (850 words & fig.)

1933 **656 .233 (.4**
Railway Gazette, No. 16, April 21, p. 555.
Railway pooling agreements sanctioned. L. M. S. a G. W.; and L. M. S., L. N. E. and G. W. schemes. (7 words.)

1933 **656 .253 (.4**
Railway Gazette, No. 17, April 28, p. 575.
Resignalling of York-Newcastle main line, London North Eastern Railway. (3 300 words & fig.)

1933 **621 .13 (**
Railway Gazette, No. 17, April 28, p. 587.
Richard Trevithick, 1771-1833. (1 300 words.)

1933 **656 .261 (.4**
Railway Gazette, No. 18, May 5, p. 609.
L. M. S. R. **road motor cartage operations.** (1 8 words & fig.)

1933 **656 .224 & 656 .23**
Railway Gazette, No. 18, May 5, p. 614.
New **automatic ticket machine.** (600 words & fi

1933 **621 .43 (.49**
Railway Gazette, No. 18, May 5, p. 615.
Railcars for speeds exceeding 200 m. p. h. (900 wo & fig.)

1933 **621 .132.6 (.47)**
ailway Gazette, No. 18, May 5, p. 616.
British-built tank locomotives for Russia. (600 words
: fig.)

1933 **656 .222 (.4)**
ailway Gazette, No. 19, May 12, p. 636.
More speeding up on the Continent. (900 words.)

1933 **656 .256.3 (.42)**
ailway Gazette, No. 19, May 12, p. 642.
Automatic signalling on Euston-Watford **electric**
nes, L. N. E. R. (3 000 words & fig.)

1933 **656 .222 (.44)**
ailway Gazette, No. 19, May 12, p. 648.
European **time-tables,** 1933-34. (2 200 words & fig.)

1933 **621 .43 (.47)**
upplement to Railway Gazette, April 21, p. 2.
BRIAN REED. — Development of **Diesel traction.**
2 900 words & fig.)

1933 **621 .43**
upplement to Railway Gazette, April 21, p. 6.
Diesel rail traction operating results. — II. Locomo-
ives. (1 700 words & table.)

1933 **621 .43 & 621 .89**
upplement to Railway Gazette, April 21, p. 9.
HUDSON (C. H.). — **Diesel engine lubrication.** (2 200
vords.)

1933 **621 .43 (.439)**
upplement to Railway Gazette, April 21, p. 10.
ZAKARIÀS (A.). — **Diesel mechanical railcars** in
Hungary — II. (1 500 words & fig.)

1933 **621 .43**
upplement to Railway Gazette, April 21, p. 14.
HEINZE (E. P. A.). — **Gebus automatical control**
system. (1 300 words & fig.)

1933 **621 .43 (.492)**
upplement to Railway Gazette, April 21, p. 15.
Important orders for Diesel railcars and locomotives.
(1 600 words & fig.)

1933 **385 .113 (.42)**
Supplement of the Railway Gazette, May 12, p. 1.
Financial and operating results of the British Group
Railways in 1932. (28 tables.)

Railway Mechanical Engineer. (Philadelphia.)

1933 **621 .392 (.73) & 625 .23 (.73)**
Railway Mechanical Engineer, April, p. 113.
An arc-welded design of passenger car. (3 400 words
& fig.).

1933 **621 .131.2 (.73)**
Railway Mechanical Engineer, April, p. 119.
LIPETZ (A. I.). — **Ratios of modern locomotives.**
Part II. (1 200 words & fig.)

1933 **625 .214**
Railway Mechanical Engineer, April, p. 122.
Journal bearing performance improved by research.
(1 800 words & fig.)

1933 **625 .213**
Railway Mechanical Engineer, April, p. 125.
HOLLAND (C. J.). — Better **railway car truck**
springs. (2 500 words & fig.)

1933 **621 .131.2 (.73)**
Railway Mechanical Engineer, May, p. 149.
GREEN (J. J.). — **Wind tunnel tests of locomotive**
streamlining. (3 600 words & fig.)

1933 **625 .245 (.73) & 625 .246 (.73)**
Railway Mechanical Engineer, May, p. 155.
All-welded hopper has cast-steel underframes. (1 500
words, 2 tables & fig.)

1933 **621 .43 (.43)**
Railway Mechanical Engineer, May, p. 160.
Articulated motor coach on German State Railways.
(1 700 words & fig.)

1933 **621 .133.3**
Railway Mechanical Engineer, May, p. 163.
Locomotive steam pipe casing. (500 words & fig.)

Railway Signaling. (Chicago.)

1933 **656 .258 (.73)**
Railway signaling, April, p. 83.
Automatic interlocking in California. (900 words &
fig.)

1933 **656 .254 (.73)**
Railway signaling, April, p. 87.
Flashing-light crossing signals on the Chicago &
Alton. (1 600 words & fig.)

1933 **656 .254 (.73)**
Railway signaling, April, p. 89.
Primary battery floating on storage for the oper-
ation of crossing signals. (500 words & fig.)

1933 **656 .25 (.73)**
Railway signaling, April, p. 90.
OLER (B. F.). — **Signaling on** the Pennsylvania's
electrified line. (3 300 words & fig.)

1933 **656 .256.1 (.73)**
Railway signaling, April, p. 96.
Remotely-controlled manual-block signal. (900 words
& fig.)

1933 **656 .254 (.73)**
Railway signaling, April, p. 98.
Texas and New Orleans to **discontinue train control.**
(600 words).

1933 **656 .255 (.73)**
Railway signaling, April, p. 99.
The benefits of either-direction signaling. (500 words
& fig.)

Transit Journal. (New York.)

1933 **625 .26**

Transit Journal, April, p. 107.

MILLER (J. A.). — **Centralized maintenance.** How far should it be carried ? (3 000 words & fig.)

1933 **621 .392 & 625 .143.3**

Transit Journal, April, p. 112.

BRAGG (J. U.). — **Rail joint failures reduced by improving welding methods.** (1 500 words & fig.)

1933 **62 (01**

Transit Journal, April, p. 115.

CUMMING (W. J.). — **Detection of cracks** in bus parts facilitated by **magnetic tester.** (900 words & fig.)

1933 **625 .212 (.73)**

Transit Journal April, p. 117.

BUCK (M.). — **Rubber cushioned wheels** evoke wide interest. (1 700 words & fig.)

In Spanish.

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1933 **621 .89**

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BODART (E.). — Contribution à l'étude du **frottement** dans la phase onctueuse et semi-fluide. (12 200 mots & fig.)

1933 **669 .1**

Revue universelle des mines, n° 12, 15 juin, p. 330.

GUZZONI (G.). — L'acier au **manganèse**, sa structure et ses propriétés. (3 100 mots & fig.) (A suivre.)

In German.

Archiv für Eisenbahnwesen. (Berlin.)

1933 **313 .385 (.3**

Archiv für Eisenbahnwesen, Januar-Februar, S. 1.

AUERSWALD. — Die **Eisenbahnen** der Erde im Jahr 1930. (1 600 Wörter.)

1933 **385. (06.12**

Archiv für Eisenbahnwesen, Januar-Februar, S. 12; März-April, S. 345.

KAESSBOHRER (A.). — Der **Verein Mitteleuropäischer Eisenbahnverwaltungen.** (21 700 Wörter.)

1933 **656 .225 (.42) & 656 .1 (.42)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 35.

GRETSCH (R.). — Das **Güterverkehrsproblem** in England. (Eisenbahn und Kraftwagen.) (8 800 Wörter & 7 Tafeln.)

1933 **385 .113 (.492)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 73.

Die **Niederländischen Eisenbahnen** im Jahr 1931, mit einer Übersicht über die Vereinheitlichung des niederländischen Eisenbahnwesens. (7 200 Wörter.)

1933 **385 .113 (.497.2)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 99.

REMY. — Die **bulgarischen Staatseisenbahnen** und Häfen 1929-1930 und 1930-1931. (2 300 Wörter & Abb.)

1933 **313 .385 (.42)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 125.

SCHELLE. — Die **Eisenbahnen** Grossbritanniens 1930. (3 500 Wörter.)

1933 **385 .113 (.45)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 146.

Die **italienischen Staatsbahnen** im Rechnungsjahr 1930-1931. (4 500 Wörter.)

1933 **385 .113 (.44)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 167.

REMY. — **Chemins de fer de Ceinture** de Paris. Geschäftsbericht 1931. (2 300 Wörter.)

1933 **385 .113 (.47.42)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 175.

NEUHAUS (H.). — Die **estländischen Staatseisenbahnen** im Geschätsjahr 1930-1931. (3 800 Wörter.)

1933 **385 .113 (.47.43**

Archiv für Eisenbahnwesen, Januar-Februar, S. 191.

RUNGIS (J.). — Die **lettländischen Eisenbahnen** i Wirtschaftsjahr 1930-1931. (3 900 Wörter.)

1933 **385 .113 (.725**

Archiv für Eisenbahnwesen, Januar-Februar, S. 211.

PAUSIN. — Die **Mexikanischen Nationaleisenbahne** im Kalenderjahr 1930. (3 800 Wörter & Karte.)

1933 **312 .385 (.62**

Archiv für Eisenbahnwesen, Januar-Februar, S. 227.

DIECKMANN. — Die **Aegyptischen Staatsbahnen** i Jahr 1930-1931. (900 Wörter.)

1933 **385. (06.1**

Archiv für Eisenbahnwesen, März-April, S. 415.

REMY. — Die **südslawischen Eisenbahnen** 1929 un 1930. (4 200 Wörter, 15 Zusammenstellungen & 2 Abb.

1933 **313 .385 (.489**

Archiv für Eisenbahnwesen, März-April, S. 447.

THOMSEN. — Die **Eisenbahnen in Dänemark** in de Betriebsjahren 1929-1930 und 1930-1931. (1 900 Wörter.

1933 **313 .385 (.485**

Archiv für Eisenbahnwesen, März-April, S. 459.

THOMSEN. — Das **schwedische Eisenbahnnetz** 192 und 1930. (3 600 Wörter.)

1933 **313 .385 (.481**

Archiv für Eisenbahnwesen, März-April, S. 475.

THOMSEN. — Die **Eisenbahnen in Norwegen** in de Jahren 1929-1930 und 1930-1931. (2 300 Wörter.)

1933 **313 .385 (.52**

Archiv für Eisenbahnwesen, März-April, S. 487.

SCHELLE. — Die **Eisenbahnen Japans** im Rechnungsjahr. (3 400 Wörter.)

Die Lokomotive. (Wien).

1933 **621 .335 (.437) & 621 .43 (.437**

Die Lokomotive, Juni, S. 101.

JANSA (F.). — 300/400 P. S. **Diesel-elektrisch Schnelltriebwagen** der Tschechoslovakischen Staats bahnen, Reihe M. 264. (1 900 Wörter & Abb.)

Elektrische Bahnen. (Berlin.)

1933 **621 .33 (.43**

Elektrische Bahnen, April, S. 73.

WECHMANN (W.). — Die Ausdehnung des **elek trischen Zugbetriebs** der Deutschen Reichsbahn auf di Linie Augsburg-Stuttgart. (1 700 Wörter & Abb.)

1933 **621 .33 (.43**

Elektrische Bahnen, April, S. 75.

FEUERLEIN. — Die bau- und betriebstechnische Einrichtungen für den **elektrischen Zugbetrieb** de Strecke Augsburg-Stuttgart. (1 900 Wörter & Abb.)

1933 621 .33 (.43)
Elektrische Bahnen, April, S. 99.
Die Deutsche Reichsbahn richtet auf 381 km. Streckenlänge **elektrischen Zugbetrieb** ein. (1 300 Wörter.)

1933 621 .33 (.436)
Elektrische Bahnen, Mai, S. 117.
Die **Elektrisierung** der Österreichischen Bundesbahnen. (1 600 Wörter & Abb.)

Glasers Annalen. (Berlin.)

1933 621 .138.5
Glasers Annalen, Heft 9, 1. Mai, S. 75.
Neue **Abzugsvorrichtung** für **Schornsteine** von in Schuppen oder ähnlichen Räumen befindlichen Maschinen wie Lokomotiven. (1 100 Wörter & Abb.)

1933 656 .211.5
Glasers Annalen, Heft 10, 15. Mai, S. 77.
SCHMELZER. — **Fahrtreppen.** (2 900 Wörter & Abb.)

1933 621 .135.3 & 625 .213
Glasers Annalen, Heft 10, 15. Mai, S. 81.
HELMUTHSTARK. — Über ein graphisches Verfahren zur Bestimmung von **gleicharmigen Blattfedern** mit gleich dicken Blättern. (1 700 Wörter & Abb.)

Organ für die Fortschritte des Eisenbahnwesens. (Berlin.)

1933 656 .21
Organ für die Fortschritte des Eisenbahnwesens, Heft 11, 1. Juni, S. 217.
MÜLLER (W.). — Neuere Methoden für die **Betriebsuntersuchung flachgeneigter Bahnhöfe.** (9 900 Wörter & Abb.)

1933 625 .151
Organ für die Fortschritte des Eisenbahnwesens, Heft 11, 1. Juni, S. 231.
HROMATKA (F.). — Instandsetzung der **Zungenvorrichtungen.** (1 900 Wörter & Abb.)

1933 621 .13
Organ für die Fortschritte des Eisenbahnwesens, Heft 12, 15. Juni, S. 235.
MEINEKE (F.). — Zur Geschichte der **Gleichstrom-Dampflokomotive.** (1 600 Wörter & Abb.)

1933 621 .135.4 & 621 .335
Organ für die Fortschritte des Eisenbahnwesens, Heft 12, 15. Juni, S. 238.
PFLANZ (K.). — Beitrag zur Untersuchung von **Kurvenlaufeigenschaften elektrischer Lokomotiven.** (2 700 Wörter & Abb.)

1933 621 .131.3
Organ für die Fortschritte des Eisenbahnwesens, Heft 12, 15. Juni, S. 243.
LUBIMOFF (W.). — Ermittlung einiger Gesetzmässigkeiten bei **Versuchsergebnissen von Dampflokomotiven.** (4 700 Wörter & Abb.)

Zeitschrift des Vereines Deutscher Ingenieure. (Berlin.)

1933 621 .33 (.43)
Zeitsch. des Ver. deutsch Ing., Nr. 20, 20. Mai, S. 533.
SCHIEB (A.). — Zur Eröffnung des **elektrischen Betriebes** auf der Berliner Wannseebahn. (2 300 Wörter & Abb.)

1933 721 .1
Zeitsch. des Ver. deutsch. Ing., Nr. 21, 27. Mai, S. 550.
HERTWIG (A.). — **Baugrundforschung.** (4 100 Wörter & Abb.)

1933 62. (01 & 621 .392
Zeitsch. des Ver. deutsch. Ing., Nr. 21, 27. Mai, S. 556.
SCHAPER (G.). — Die Dauerfestigkeit der **Schweissverbindungen.** (3 500 Wörter & Abb.)

1933 621 .133.1
Zeitsch. des Ver. deutsch Ing., Nr. 21, 27. Mai, S. 565.
SCHULTE (Fr.) & TANNER (E.). — Stand und Entwicklung der **Feuerungstechnik.** (5 900 Wörter & Abb.)

1933 625 .23 (0
Zeitsch. des Ver. deutsch. Ing., Nr. 22, 3. Juni, S. 591.
MÜLLER (L.). — Schwerpunktsbestimmung und Gewichtsausgleich an Wagenkästen von **Drehgestell-Personenwagen.** (2 000 Wörter & Abb.)

1933 62. (01 & 621 (01
Zeitsch. des Ver. deutsch. Ing., Nr. 23, 10. Juni, S. 610.
BACH (J.). — Der Stand des **Knickproblems** stabförmiger Körper unter besondrer Berücksichtigung der Bedürfnisse des Maschinenhaus. (4 000 Wörter & Abb.)

1933 621 .132.1 (.56)
Zeitsch. des Ver. deutsch Ing., Nr. 23, 10. Juni, S. 624.
CHRISTEL (E.). — **Neue Lokomotivbauarten** der Türkischen Staatsbahnen. (1 000 Wörter & Abb.)

1933 62. (01
Zeitsch. des Ver. deutsch. Ing., Nr. 24, 17. Juni, S. 629.
LUDWIK (P.) & KRYSTOF (J.). — Einfluss der Vorspannung auf die **Dauerfestigkeit.** (5 800 Wörter & Abb.)

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen. (Berlin.)

1933 656 .254 & 621 .31
Zeitsch. für das gesamte Eisenb.-Sicherungsw., Nr. 7, 20. Mai, S. 73.
van BIEMA. — Wirtschaftliche Stromversorgung für **Zugmeldeeinrichtungen.** (1 500 Wörter & Abb.)

1933 656 .25 (.42)
Zeitsch. für das gesamte Eisenb.-Sicherungsw., Nr. 7, 20. Mai, S. 75.
GRADL & WINZLER. — Über das englische **Eisenbahn-Sicherungswesen.** Reiseeindrücke und Beobachtungen. (1 900 Wörter & Abb.)

Zeitung des Vereins Mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

1933 **656. 212**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 20, 18. Mai, S. 409.
BALLOF. — Die Überwachung der wirtschaftlichen **Betriebsführung in Verschiebebahnhöfen.** (7 800 Wörter & Abb.)

1933 **621 .132.3 (.43)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 21, 25. Mai, S. 429.
WITTE (Fr.). — Die **Lokomotiven** der Deutschen Reichsbahn im Personenzugdienst. (2 300 Wörter.)

1933 **385. (09**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 21, 25. Mai, S. 435.
SERAPHIN (P. H.). — Das **Eisenbahnwesen** Finnlands. (2 300 Wörter & 8 Tabellen.)

1933 **621 .33 (.43)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 22, 1. Juni, S. 449.
NADERER. — Der **elektrische Zugbetrieb** der Fernbahn Augsburg-Stuttgart und der Stuttgarter Nahbahnen. (2 800 Wörter.)

1933 **625 .245 & 656 .225**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 22, 1. Juni, S. 454.
BÄSELER. — Der kommende **Behälterverkehr.** (1 800 Wörter.)

1933 **656**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 23, 8. Juni, S. 469.
THAYSSEN. — **Deutscher-Flugeisenbahn-Expressgutverkehr.** (8 300 Wörter.)

1933 **385**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 23, 8. Juni, S. 479.
WENTZEL. — **Eisenbahnwerbung und Fahrzeug.** (3 200 Wörter.)

1933 **656 .222.5 (.43)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 24, 15. Juni, S. 493.
BAUMGARTEN. — Der **Personenverkehr** der Deutschen Reichsbahn im Jahre 1932. (7 800 Wörter.)

1933 **656 .234 (.43)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 24, 15. Juni, S. 505.
FRITZE. — 16 Monate **Netz- und Bezirkskarten** bei der Reichsbahn. (2 300 Wörter.)

1933 **656 .1 (.494) & 656 .2 (.494)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 24, 15. Juni, S. 508.
COTTIER. — Die von den Eisenbahnen und den Automobilinteressenten in Aussicht genommene **Verkehrsteilung und Zusammenarbeit** von Eisenbahn und Kraftlastwagen in der Schweiz. (2 100 Wörter & Abb.)

In English.

Engineer. (London.)

1933 **621 .132.3 (.44)**
Engineer, No. 4036, May 19, p. 507.
New French locomotive. (500 words & fig.)

1933 **621 .392 & 669 .1**
Engineer, No. 4036, May 19, p. 510.
The effect of **heat treatment of welds.** (2 200 words.)

1933 **621 .43 (.42)**
Engineer, No. 4037, May 26, p. 533.
A 270 B. H. P. **oil-electric locomotive.** (500 words & fig.)

1933 **621 .31 (.42)**
Engineer, No. 4038, June 2, p. 547.
Battersea **power station.** Turbo-generators. (4 000 words & fig.)

1933 **614 .8**
Engineer, No. 4039, June 9, p. 577.
Human fallibility on the railway. (1 000 words.)

1933 **621 .94**
Engineer, No. 4039, June 9, p. 580.
A kneeless plain **milling machine.** (1 500 words & fig.)

1933 **621 .94**
Engineer, No. 4039, June 9, p. 583.
A vertical **automatic lathe.** (1 700 words & fig.)

1933 **621 & 669 .1**
Engineer, No. 4039, June 9, p. 585.
The use of **rolled steel in machine construction.** (4 000 words.)

1933 **621 .392**
Engineer, No. 4040, June 16, p. 599.
A new **arc welding transformer.** (1 200 words & fig.)

1933 **621 .392 (.42) & 625 .246 (.42)**
Engineer, No. 4040, June 16, p. 600.
L. N. E. R. **welded wagon underframes.** (1 300 words & fig.)

1933 **669**
Engineer, N. 4040, June 16, p. 609.
BOEX (G.). — Applications of **aluminium and its alloys.** (3 000 words & fig.)

Engineering. (London.)

1933 **62. (01 & 656 .28 (01**
Engineering, No. 3514, May 19, p. 554.
SCHUSTER (L. W.). — The investigation of the **mechanical breakdown of prime movers and boiler plant.** (3 900 words & fig.)

1933 **385 .1 (.42)**
ngineering, No. 3515, May 26, p. 573.
Railway developments. (2 800 words.)

1933 **621 .31 (.42)**
ngineering, No. 3516, June 2, p. 585.
67 200-kw. **turbo-alternator** for the Battersea station the London Power Company. (2 800 words & fig.)

1933 **669**
ngineering, No. 3516, June 2, p. 592; No. 3517, June 9, p. 633.
BOEX (G.). — The **aluminium industry** in Scotland. per read before the Institution of Mechanical Engin-rs at Edinburgh, May 30, 1933. Abridged. (9 200 ords & fig.)

1933 **621 .94**
ngineering, No. 3517, June 9, p. 619.
Six-spindle vertical **automatic lathe.** (2 600 words fig.)

1933 **621 .14 (09**
ngineering, No. 3518, June 16, p. 639.
GILLFORD (F. H.). — The development of the **action engine.** (4 300 words & fig.)

1933 **621 .132.8**
ngineering, No. 3518, June 16, p. 653.
xpress **rail-car traction.** (2 000 words.)

1933 **62 (.01 & 656 .28**
ngineering, No. 3518, June 16, p. 661.
The investigation of the **mechanical breakdown of rime movers and boiler plant.** Paper read by Mr. L. W. CHUSTER before the Institution of Mechanical Engin-ers, on 28 April, 1933. Abridged.

Engineering News-Record. (New York.)

1933 **62. (01, 621 .99 & 669 .1**
ngineering News-Record, No. 19, May 11, p. 584.
LYSE (I.). — Testing **riveted joints** of cromansil eel. (650 words & fig.)

1933 **624 .2**
ngineering News-Record, No. 19, May 11, p. 594.
Wood-beam design method promises economies. (1 600 ords & fig.)

1933 **621 .392 (.94) & 624 (.94)**
ngineering News-Record, No. 19, May 11, p. 596.
McCORMACK (W. T. B.). — **Bridge welding** prac-ices in Australia. (1 400 words & fig.)

1933 **621 .392 & 624**
ngineering News-Record, No. 22, June 1, p. 706.
MELICK (C. A.). — Old **steel road bridges restored y welding.** (2 300 words & fig.)

Great Western Railway Magazine. (London.)

1933 **656**
reat Western Railway Magazine, May, p. 197.
Britain's first **railway-operated air-service.** (2 000 ords & fig.)

Indian Railway Gazette. (Calcutta.)

1933 **621 .132.8 (.47)**
Indian Railway Gazette, May, p. 99.
British-built **locomotive** for the U. S. S. R. — **Heaviest steam locomotive built in Europe.** (2 700 words & fig.)

Journal, Institution of Engineers, Australia. (Sydney.)

1933 **621 .86 (.944) & 651 (.944)**
Journal, Institut. of Eng., Australia, April, p. 109.
BROWNLOW CORBETT (A.). — **Mechanical handling of mails,** General Post Office, Sydney. (8 000 words & fig.)

1933 **621 .392, 625 .143. (0 & 625 .143.4**
Journal, Institut. of Eng., Australia, April, p. 122.
FARGHER (J. A.). — **Temperature stresses in welded railway track.** (6 000 words & fig.)

Journal, Institute of Transport. (London.)

1933 **656 (0**
Journal, Institute of Transport, June, p. 420.
BELL (R.). — **Transport developments in 1932.** (7 500 words.)

1933 **656 .2 & 659**
Journal, Institute of Transport, June, p. 430.
BALLANTYNE (J.). — **Commercialism in relation to railways.** (6 700 words.)

1933 **656. 213 (.4)**
Journal, Institute of Transport, June, p. 439.
ROBERTS (A. H.). — Modern **dock facilities.** (6 200 words.)

Journal, Permanent Way Institution. (London.)

1933 **625 .141**
Journal, Perm. Way Institut., April, p. 65.
LAWSON (F.). — **Slag ballast,** production and distribution. (4 200 words & fig.)

1933 **625 .113**
Journal, Perm. Way Institut., April, p. 78.
FURNIVALL (S. L.). — The re-alignment of **railway curves.** (4 500 words & fig.)

1933 **656 .227 (.42)**
Journal. Perm. Way Institut., April, p. 94.
BUSSELL (H. J.). — **The conveyance of exceptional** (or « out-of-gauge ») **loads** — An outline of G. W. R. practice. (8 000 words & fig.)

1933 **625 .62 (.42)**
Journal, Perm. Way Institut., April, p. 113.
SHAW (D. D.). — Modern **tramway maintenance.** (1 400 words.)

The Locomotive. (London.)

1933 621 .335 (.41) & 621 .43 (.41)
The Locomotive, June 15, p. 168.
Diesel-electric locomotive for the Belfast & County Down Ry. (1 000 words & fig.)

1933 625 .26
The Locomotive, June 15, p. 184.
EYLES (A. J. T.). — **Repair** methods on damaged **all-metal coaches.** (1 700 words & fig.)

1933 621 .132.1 (.52)
The Locomotive, June 15, p. 192.
Recent locomotives, Imperial Japanese Rys. (600 words, 1 table & fig.)

Mechanical Engineering. (New York.)

1933 614 .7
Mechanical Engineering, June, p. 347.
CHRISTY (W. G.). — The human side of **smoke** abatement. (5 600 words.)

1933 694
Mechanical Engineering, June, p. 355.
HILL (P. S.). — **Plywood as a building material.** (1 800 words & fig.)

Modern Transport. (London.)

1933 621 .43 (.42)
Modern Transport, No. 740, May 20, p. 3.
Diesel-electric traction in Ireland. (800 words & fig.)

1933 656 .253 (.42)
Modern Transport, No. 741 May 27, p. 3.
Noteworthy **power signalling** on the L. N. E. R. (3 400 words & fig.)

1933 347 .763 (.42) & 388 (.42)
Modern Transport, No. 741, May 27, p. 5.
London Transport Act. — **No. 2.** Passenger fares and pooling of receipts. (2 600 words). (To be continued.)

1933 621 .43 (.42)
Modern Transport, No. 741, May 27, p. 7.
Petrol railcar in Northern Ireland. (500 words & fig.)

1933 656 .253 (.42)
Modern Transport, No. 742, June 3, p. 3.
Battery-operated colour-light signals. New installation on L. N. E. R. (1 800 words & fig.)

1933 624 .63 (.42)
Modern Transport, No. 742, June 3, p. 5.
Concrete viaducts for Greenisland loop line, L. M. S. R. (2 600 words & fig.)

1933 656 .261 (.42)
Modern Transport, No. 742, June 3, p. 6.
Economy in collection and delivery. The Scammell « mechanical horse ». (1 500 words & fig.)

1933 385 .1 (.54
Modern Transport, No. 742, June 3, p. 7.
FREELAND (Sir Henry). — The **transport problen** in India. Revised railway methods needed to meet roa competition. (6 000 words.)

1933 625 .62 (.42
Modern Transport, No. 742, June 3, p. 11.
Leeds City Tramways and transport. Some recen developments. (2 700 words & fig.)

1933 659 (.42
Modern Transport, No. 742, June 3, p. 17.
First « Show » train in Great Britain. Railways an Traders co-operate. (900 words & fig.)

1933 621 .392 (.42) & 625 .246 (.42
Modern Transport, No. 744, June 17, p. 3.
Wagon underframes on the L. N. E. R. **Welded underframes.** (1 400 words & fig.)

1933 621 .335 (.489) & 621 .43 (.489
Modern Transport, No. 744, June 17, p. 5.
Oil-electric locomotives in Denmark. Developments o private-owned railways. (1 200 words & fig.)

Proceedings, American Society of Civil Engineers (New York.)

1933 624 .
Proc., Amer. Soc. of Civil Eng., May, p. 763.
GOLDBERG (J. E.). — **Wind stresses** by slope deflec tions and converging approximations. (5 000 word & fig.)

1933 55, 624 .1 & 721 .
Proc., Amer. Soc. of Civil Eng., May, p. 777.
Earths and foundations. Progress report of Specia Committee. (12 000 words & fig.)

Proceedings, Institution of Railway Signal Engineers. (Reading).

1932-33 656 .25 (
Proceed., Institut. of Ry. Signal Engineers, November-January, p. 241.
BAKER (E. W.). — **Signal lamps** and kerosene oils — Paper and discussion. (25 000 words.)

1932-33 656 .25
Proceed., Institut. of Ry. Signal Engineers, November-January, p. 318.
ROSE (A. C.). — **Signals and sand drags.** — Pape and discussion. (9 800 words.)

1932-33 656 .25 (
Proceed., Institut. of Ry. Signal Engineers, November-January, p. 342.
WOOD (W.). — **Lightning protection and interferenc from high voltage.** — Paper and discussion. (11 00 words.)

1932-33 656 .255 (.42)
roceed., Institut. of Ry. Signal Engineers, November-January, p. 373.
BRYSON (W.). — **Token exchange apparatus in Scotnd (L. M. S. R.).** — Paper and discussion. (7 000 ords.)

Railway Age. (Philadelphia.)

1933 624 .32 (.73)
ailway Age, No. 18, May 6, p. 658.
Louisville & Nashville completes outstanding bridge. 300 words & fig.)

1933 347. 763 (.73)
ailway Age, No. 18, May 6, p. 668.
President Roosevelt approves **Transportation Bill.** 500 words.)

1933 347 .763 (.73)
ailway Age, No. 19, May 13, p. 688.
Railroad co-ordinator not to be Czar. — President oosevelt's emergency transportation act intended to lp the railroads help themselves. (6 800 words.)

1933 656. 25 (06 (.73)
ailway Age, No. 19, May 13, p. 693.
Signal Section (A. R. A.) meets in New York. (2 800 ords.)

1933 621 .131.2 (.71)
ailway Age, No. 19, May 13, p. 695.
Locomotive streamlining developed by wind tunnel st. (1 300 words & fig.)

1933 621 .133.4 & 621 .133.5
ailway Age, No. 20, May 20, p. 723.
Soo Line tests cyclone front end. (2 400 words & fig.)

1933 625 .142.2 (.73)
ailway Age, No. 20, May 20, p. 734.
How about the **crosstie** problem ? (5 300 words.)

1933 385. (064 (.73)
ailway Age, No. 21, May 27, p. 754.
Railroads an important feature at World's Fair. 000 words & fig.)

1933 625 .162 (.73) & 656 .254 (.73)
ailway Age, No. 21, May 27, p. 771.
Alton replaces crossing flagmen with signals. (700 ords & fig.)

1933 656 .1 (.73)
ailway Age, No. 21, May 27, p. 772.
Railroad annual reports review **motor transport erations.** (3 000 words & fig.)

1933 656 .261 (.73)
ailway Age, No. 21, May 27, p. 775.
Central Vermont co-ordinated service. An effective affic **developer.** (1 700 words.)

1933 625 .23 (0 (.73) & 625 .232 (.73)
Railway Age, No. 22, June 3, p. 789.
Pullman **aluminium cars** mark new era in car construction. (3 400 words & fig.)

1933 625 .142 (.73)
Railway Age, No. 22, June 3, p. 794.
PARMELEE (Dr. J. H.). — **Balancing supply and demand in crossties.** (3 000 words & fig.)

1933 656 .254 (.73)
Railway Age, No. 22, June 3, p. 801.
Telephone communication system for freight trains. (700 words & fig.)

Railway Engineer. (London.)

1933 621 .392
Railway Engineer, June, p. 161.
Fusion welding at home and abroad. (800 words.)

1933 621 .95
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A four-spindle machine for chair **reamering.** (250 words & fig.)

1933 621 .85 (.42) & 725 .43 (.42)
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Interesting **foundry development** at Eastleigh Works, Southern Railway. (2 700 words & fig.)

1933 621 .331
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GERCKE (M.). — **Energy supply** for suburban railways. (2 000 words & fig.)

1933 621 .39
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1933 621 .132.3 (.931)
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New **4-8-4 locomotive,** New Zealand Government Railways, designed for heavy passenger service in the North Island. (350 words & fig.)

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1933 656 .253 (.43)
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1933 694
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New **connectors** strengthen **wood joints.** (2 500 words & fig.)

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LANZ (S. G.). — Eliminating the hazard. (1 700 words & fig.)

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A new type of **railway wheel.** (450 words & fig.)

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New **oxygen cutting machine.** (900 words & fig.)

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Relatório e contas correspondentes ao 29° exercicio. (Abrangendo o ano civil de 1932.)

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[016 .385. (05]

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1933 625 .113

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LAMOEN (J.). — Le tracé des raccordements progressifs. (8 700 mots et fig.) (A suivre.)

1933 385 .21 (.493)

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DE BRABANDERE. — Le rail et l'eau ou les chemins de fer et les voies navigables et le canal Albert (24 700 mots et fig.)

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1933 62. (01 & 691

Arts et Métiers, juin, p. 194.

PORTIER (H.). — Contribution au problème de l'allègement des constructions. (14 000 mots et fig.)

1933 62 (01

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MATHIEU (M.). — Résistance des matériaux et légèreté des constructions. (4 300 mots).

1933 669

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PUBELLIER (M.). — Le calcul des pièces en duralumin. (15 100 mots et fig.)

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1933 621 .13 (09

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SAUVAGE (E.). — Notes sur les locomotives. (6 000 mots et fig.)

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1933 621 .392

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JEAN LOUIS. — La soudure électrique et la construction des réservoirs soudés. (1 700 mots.)

1933 621 .43

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1933 385 .113 (.42

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SHERRINGTON (C. E. R.). — Les quatre grande compagnies de chemins de fer de Grande-Bretagn pendant l'exercice 1932. (12 000 mots et 39 tableaux.

1933 385. (09 (.45

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1933 656 .223.

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von NANASSY (B.). — A propos de la réglementation des rapports juridiques en matière de wagons marchandises appartenant à des particuliers. (6 00 mots.)

1933 385 .113 (.495

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1933 313 .385 (.497.1

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1933 313 .385 (.439

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Chronique des transports. (Paris.)

1933 385 .113 (.44

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La Compagnie des chemins de fer du Nord en 1932 (4 600 mots.)

1933 385 .113 (.44

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Les résultats d'exploitation des grands réseaux d chemins de fer en 1932. (9 600 mots.)

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1933 621 .335 & 621 .43

Génie civil, n° 2655, 1er juillet, p. 17.

Les locomotives Diesel-Sulzer de grande puissanc pour trains rapides et trains de marchandises. (1 70 mots et fig.)

1933 621 .132.8 (.73) & 621 .43 (.73)
énie civil, n° 2656, 8 juillet, p. 43.
L'automotrice américaine Budd-Micheline, à ban-ages pneumatiques. (400 mots et fig.)

1933 669 .1
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PORTEVIN (A.). — L'évolution des procédés d'épu-ation de l'acier. (5 700 mots.)

1933 625 .142.3
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Traverses métalliques, de construction belge, pour oies ferrées. (600 mots et fig.)

L'Allègement dans les Transports. (Lucerne.)

1933 625 .215
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WORMS (J.) & BONNET (M.). — Les procédés 'égalisation des charges dans les bogies. (2 600 mots t fig.)

1933 621 .43
'Allègement dans les Transports, juillet-août, p. 89.
FONTANELLAZ (E.). — Nouveau projet d'automo-rice légère. (5 400 mots et fig.)

La Traction électrique. (Paris.)

1933 621 .33
a Traction Electrique, mars, p. 36.
Le développement de l'électrification des chemins le fer dans les principaux pays. (Suite.) (1 500 mots.)

1933 621 .337
a Traction Electrique, avril, p. 49.
HUG (A. M.). — La commande individuelle des ssieux: des systèmes utilisés pour locomotives et notrices dans l'exploitation des voies ferrées de toute nature. (6 300 mots et fig.) (A suivre.)

1933 621 .33 (.45)
a Traction Electrique, mai, p. 69.
FIORENTINI (F.). — Le chemin de fer électrique le Voghera à Varzi à courant continu à 3 000 volt. (6 900 mots et fig.)

Les Chemins de fer et les Tramways. (Paris.)

1933 621 .132.3 (.44)
Les Chemins de fer et les Tramways, juillet, p. 155.
CHAPELON (A.). — Transformation des locomo-ives Pacific de la série 3 700 de la Compagnie d'Or-éans. (8 200 mots et fig.)

1933 625 .144.1 & 621 .392
Les Chemins de fer et les Tramways, juillet, p. 165.
LEGUILLOCHET (R.). — La voie soudée. (5 000 mots.)

1933 62. (01
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DESGARDES (E.). — Machine pour l'essai, à la flexion, des métaux en barres rondes, carrées ou rec-tangulaires. (2 300 mots et fig.)

1933 656 .212.2 & 656 .213
Les Chemins de fer et les Tramways, juillet, p. 172.
DUCHESNOY. — Entrepôts frigorifiques et gares laitières. (8 000 mots et fig.)

L'Industrie des voies ferrées et des transports automobiles. (Paris.)

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L'Ind. des voies ferrées et des transp. autom., mai, p. 144.
FISCHER. — Nouvelles automotrices en service aux Tramways de Mulhouse. (2 200 mots et fig.)

1933 625 .62 (.45)
L'Ind. des voies ferrées et des transp. autom., juin, p. 174.
VENTE (R.). — Les nouvelles voitures du réseau de Milan. (1 900 mots et fig.)

Rail et Route. (Paris.)

1933 656 .1 (.494) & 656 .2 (.494)
Rail et Route, juin, p. 87.
Le premier accord national entre le rail et la route est signé en Suisse. (3 800 mots et fig.)

1933 625 .244
Rail et Route, juin, p. 97.
PIETTRE (M.). — Transport des viandes abattues par cadres isothermes. (2 600 mots et fig.)

1933 656 .23 (0
Rail et Route, juillet, p. 107.
La simplification des tarifs ferroviaires. (2 700 mots.)

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1933 669 .1
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DORLET (E.). — Note sur les aciers spéciaux de construction. (5 000 mots et fig.)

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1933 656 .222.5 (.44)
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BARRET. — Accélération des trains omnibus des lignes secondaires sur le réseau du Nord. (5 700 mots et fig.)

1933 **625 .244 (.44)**
Revue générale des chemins de fer, juillet, p. 15.
HEURTAULT. — Essais de nouveaux **procédés de calorifugeage** pour wagons isothermes réalisés à la Compagnie d'Orléans. (7 500 mots, 4 tableaux et fig.)

1933 **651**
Revue générale des chemins de fer, juillet, p. 32.
RICHET. — Emploi des **machines à statistiques** pour l'obtention de différents renseignements concernant les trains de marchandises. (3 600 mots et fig.)

1933 **621 .33 (.65)**
Revue générale des chemins de fer, juillet, p. 41.
NICOLET (V.). — **Electrification** de la ligne de Bône à Oued-Kébérit, des Chemins de fer algériens de l'Etat. (5 700 mots et fig.)

1933 **656 .222.1 (.3)**
Revue générale des chemins de fer, juillet, p. 64.
L'accélération des relations ferroviaires dans le monde pour le service d'été 1933. (2 300 mots et 3 tableaux.)

1933 **625 .232 (.44)**
Revue générale des chemins de fer, juillet, p. 69.
Des **wagons-lits de 3e classe** en France. (800 mots et fig.)

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1933 **385 (.3)**
Revue politique et parlementaire, 10 juillet, p. 3.
La **situation des chemins de fer** à l'étranger et en France. (15 000 mots.)

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1933 **669 .1**
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GUZZONI (G.). — L'acier **au manganèse,** sa structure et ses propriétés. (2 000 mots, 4 tableaux et fig.)

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1933 **621 .132.5 (.43)**
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1 E - **Vierzylinder - Verbund - Heissdampf - Mitteldruck - Güterzug -Lokomotive** der deutschen Reichsbahn. (700 Wörter & Abb.)

1933 **621 .132.8 & 621 .43**
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ÜLLER (W.). — **Dieselmotorlokomotiven** für Schnell- und Güterzüge. (5 100 Wörter & Abb.)

Die Reichsbahn. (Berlin.)

1932 **385 .113 (.43**
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Die Deutsche Reichsbahn im Jahre 1932. **Vorläufige Jahresrückblick.** (27 Seiten.)

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1933 **625 .25**
Elektrische Bahnen, Juni, S. 125.
STEINER (F.) & BODMER (C.). — Versuche mi **elektromagnetischen Schienenbremsen** im Vollbahn betrieb. (1 300 Wörter, 2 Tabelle & Abb.)

1933 **621 .33 (.436)**
Elektrische Bahnen, Juni, S. 129.
LUITHLEN (H.). — Ein Überblick über die **Elektrisierung** der Österreichischen Bundesbahnen. (4 300 Wörter, 4 Tafeln & Abb.)

1933 **621 .33 (.728.6)**
Elektrische Bahnen, Juni, S. 142.
SÜBERKRÜB & KOPP (W.). — Erste **tropische Bahn** mit **Einphasen-Wechselstrom.** (2 500 Wörter & Abb.)

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1933 **656 .211.5**
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SCHMELZER. — **Fahrtreppen.** (3 500 Wörter.)

1933 **621 .135.3 & 625 .213**
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BLOCH (A.). — Die Berechnung der **Rückstellkraft von Federgehängen.** (600 Wörter & Abb.)

1933 **621 .134.2**
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LUBIMOFF (W.). — Uber die Grösse der Einlassdeckung bei der **Heusinger (Walschaert)-Steuerung.** (2 900 Wörter & Abb.)

Organ für die Fortschritte des Eisenbahnwesens. (Berlin.)

1933 **656 .212.3**
Organ für die Fortschritte des Eisenbahnwesens, Heft 13, 1. Juli, S. 253.
KÜMMELL. — Uber die **Ausbildung der Unterwegsbahnhöfe,** insbesondere des Ausziehkopfes. (3 300 Wörter & Abb.)

1933 **625 .143.3**
Organ für die Fortschritte des Eisenbahnwesens, Heft 13, 1. Juli, S. 257.
KÜHNEL. — **Spannungen in Schienen,** ihre Ursachen und ihre Wirkung auf die Bruchsicherheit. (2 000 Wörter & Abb.)

1933 **625 .173**

rgan für die Fortschritte des Eisenbahnwesens, Heft 13, 1. Juli, S. 260.

STUBEL. — **Maschinelle Erneuerung der Gleisbet-ing,** Verfahren Neddermeyer. (2 800 Wörter & Abb.)

1933 **625 .142.2**

rgan für die Fortschritte des Eisenbahnwesens, Heft 13, 1. Juli, S. 264.

KRÖH (F.). — Ist das **Doppel-Rüping-Verfahren** ir die Tränkung von Buchenholz genügend (2 000 Vörter & Abb.)

1933 **621 .138.3 (.43), 621 .138.5 (.43) & 625 .26 (.43)**

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GREHLING. — Plan und Wirtschaft in der **Fahr-eugunterhaltung.** (8 300 Wörter & Abb.) (Schluss olgt.)

1933 **621 .131.3**

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LEHNER. — **Vergleichsversuche** mit einer Zwillings-nd einer Drillingslokomotive. (2 800 Wörter & Abb.)

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1932 **656**

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PIRATH. — **Verkehrspolitik und Verkehrseinheit.** Eine amerikanische Stimme (Kundgebung des Präsi-enten Roosevelt). (2 Seiten.)

1932 **656 .222.5 .(43) & 621 .132.8 (.43)**

'erkehrstechnische Woche, Nr. 52, S. 723.

Schnellere Personenbeförderung und Verwendung on **Triebwagen** bei der Reichsbahn. (5 Seiten.)

1932 **625 .113**

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RAMGE. — Zum Entwurf von **Gegenkrümmungen** or Bahnhöfen. (2 Seiten & Zeichn.)

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1933 **62. (01**

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KIRCHBERG (G.). — **Eigenspannungen** in grossen Schmiedestücken. (1 000 Wörter & Abb.)

1933 **62 .4**

Zeitsch. des Ver. deutsch. Ing., Nr. 28, 15. Juli, S. 773.

GOTTFELDT (H.). — Massnahmen zur Verringerung der **Bauhöhe breiter Strassenbrücken.** (1 800 Wörter & Abb.)

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1933 **656 .25 (.42)**

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GRADL & WINZLER. — Über das englische **Eisenbahn-Sicherungswesen.** (2 100 Wörter & Abb.)

1933 **656 .257**

Zeitsch. für das gesamte Eisenb.-Sicherunsw., Nr. 9, 10. Juli, S. 105.

WAGNER (Th.). — Neuzeitliche Entwicklung der **Ablaufstellwerke.** (2 400 Wörter & Abb.)

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1933 **385 .113 (.43)**

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JAHN (A.). — Der **Geschäftsbericht** der Deutschen Reichsbahn-Gesellschaft über das 8. Geschäftsjahr 1932. (3 500 Wörter.)

1933 **621 .33 (.485)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 25, 22. Juni, S. 521.

PASZKOWSKI. — Die wirtschaftliche Bedeutung der **Schwedischen Staatsbahnelektrisierung.** (5 000 Wörter & 1 Karte.)

1933 **385 .1 (.43)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 26, 29. Juni, S. 537, Nr. 27, 6. Juli, S. 557.

JAEGER. — Finanzfragen im **Beschaffungswesen** der Reichsbahn. (7 400 Wörter.)

1933 **625 .19 (.43)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 27, 6. Juli, S. 562.

HERRENKIND. — **Felssprengungen** an der Steilwand des Bohlen bei Saalfeld (Saale) im Jahre 1931. (2 800 Wörter & Abb.)

1933 **656 .237 (.43)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 28, 13. Juli, S. 577.

BUSCH. — Die **Auswertung der Abrechnung** unter den Reichsbahnbezirken. (4 300 Wörter.) (Fortsetzung folgt.)

In English.

Engineer. (London.)

1933 **625 .13**

Engineer, No. 4042, June 30, p. 645.

BALL (J. D. W.). — **Relining curves by offsets.** (2 700 words & fig.)

1933 **621 .392**
Engineer, No. 4042, June 30, p. 659.
A **portable electric welding set.** (500 words & fig.)

1933 **627** (.42) **& 656** .213 (.42)
Engineer, No. 4043, July 7, p. 3; No. 4044, July 14, p. 27; No. 4045, July 21, p. 52.
Southampton dock extensions (9 300 words & fig.)

1933 **621** .132.1 (.42 + .73)
Engineers, No. 4043, July 7, p. 13.
British and American locomotives. (1 500 words.)

1933 **621** .132.3 (.42)
Engineer, No. 4043, July 7, p. 16.
L. M. S. 4-6-2 « Pacific » locomotive. (1 700 words & fig.)

1933 **621** .43 (.42)
Engineer, No. 4043, July 7, p. 18.
A **railbus.** (400 words & fig.)

1933 **614** .7
Engineer, No. 4044, July 14, p. 40.
Instrument for measuring smoke. (900 words & fig.)

1933 **656** .222.1 (.44)
Engineer, No. 4044, July 14, p. 40.
French railway speeds. (500 words.)

1933 **656** .284 (.42)
Engineer, No. 4044, July 14, p. 41.
The **Fairbourne railway accident.** (1 400 words & fig.)

1933 **656** .28 (0 (.42)
Engineer, No. 4044, July 14, p. 44.
The **annual report on railway accidents.** (600 words & 1 table.)

1933 **536**
Engineer, No. 4045, July 21, p. 54.
PETTY (Th.). — **Tube diameter and heat transmission.** (800 words, 1 table & fig.)

1933 **656** .1
Engineer, No. 4045, July 21, p. 55.
Tractor for 15-ton oversea transport unit. (5 200 words & fig.)

1933 **621** .132.3 (.62)
Engineer, No. 4045, July 21, p. 58.
Egyptian State Railways' **converted Atlantic locomotive.** (500 words & fig.)

1933 **621** .132.3 (.42)
Engineer, No. 4045, July 21, p. 63.
A **new express locomotive.** (1 200 words.)

1933 **62.** (01
Engineer, No. 4045, July 21, p. 68.
Simplified **pendulum hardness tester.** (350 words & fig.)

1933 **624** (.42) **& 625** .13 (.42
Engineer, No. 4045, July 21, p. 72.
Craigavon bridge, Londonderry. (1 100 words & fig

1933 **621.** (06 (.485
Engineer, No. 4046, July 28, p. 80.
The World Power Conference. The Scandinavian sectional meeting. (5 800 words.)

1933 **62.** (0
Engineer, No. 4046, July 28, p. 84.
The **planimeter.** (4 500 words & fig.)

1933 **621** .43 (.42
Engineer, No. 4046, July 28, p. 86.
130 H. P. **oil-engined railcar.** (850 words & fig.)

1933 **621** .132.3 (.41
Engineer, No. 4046, July 28, p. 96.
2-6-0 **Superheater locomotive,** Northern Countie Committee, L. M. S. Ry. (550 words & fig.)

1933 **621** .331 .(42)
Engineer, No. 4046, July 28, p. 97.
Glass bulb rectifiers on L. M. S. Ry. (1 400 words & fig.)

1933 **691**
The Metallurgist, Supplem. to the Engineer, June 30, p. 36.
STEPHEN (R. A.) & JONES (W. R. D.). — **Recovery of steel after fatigue testing.** (700 words & fig.)

1933 **62.** (01
The Metallurgist, Supplem. to the Engineer, June 30, p. 43.
Sulphur printing. (450 words.)

1933 **62.** (01
The Metallurgist, Supplem. to the Engineer, June 30, p. 46.
The standardisation of the scleroscope test for specification use. (2 100 words & fig.)

Engineering. (London.)

1933 **621** .31 (.42)
Engineering, No. 3519, June 23, p. 667.
67 200-kw. **turbo-alternator** for the Battersea Station of the London Power Company. (1 400 words & fig.)

1933 **621** .116
Engineering No. 3519, June 23, p. 672.
The three-element **feed-water regulator.** (1 500 words & fig.)

1933 **669** .1
Engineering, No. 3519, June 23, p. 674.
The **Perrin steel deoxidising process.** (1 500 words & tables.)

1933 621 .43
ngineering, No. 3519, June 23, p. 676.
300 H. P. petrol locomotive for the Bermuda Railay. (2 400 words & fig.)

1933 385. (09 (.42)
ngineering, No. 3519, June 23, p. 693.
Trevithick's London Exhibition railway of 1808. 800 words & fig.)

1933 627 (.42)
ngineering, No. 3519, June 23, p. 696.
New graving dock at Southampton. (3 700 words.)

1933 536
ngineering, No. 3520, June 30, p. 707.
The properties of steam. (1 800 words.)

1933 621 .132.3 (.42)
ngineering, No. 3521, July 7, p. 21.
4-6-2 type express passenger locomotive for the M. S. Ry. (1 400 words & fig.)

1933 621 .392 (.73) & 625 .173 (.73)
ngineering, No. 3522, July 14, p. 33.
Self-propelled welder for railway track work. (700 ords & fig.)

1933 621 (06 (.485)
ngineering, No. 3522, July 14, p. 43; No. 3523, July 21, p. 70.
The Scandinavian sectional meeting of the World wer Conference. (6 800 words.)

1933 621 .132.3 (.43)
ngineering, No. 3523, July 21, p. 49.
4-6-2 type four-cylinder compound express locomoves for the German State Railways. (650 words.)

1933 669 .1
ngineering, No. 3523, July 21, p. 50.
PFEIL (L. B.) & JONES (D. G.). — A contribution the study of the properties of austenitic steels. 800 words, tables & fig.)

1933 62. (01
ngineering, No. 3523, July 21, p. 55; No. 3524, July 28, p. 80.
CUTHBERTSON (J. W.). — Fatigue testing. (2 900 ords.)

1933 669 .1
ngineering, No. 3524, July 28, p. 58.
The manufacture of rapid machining steel. (5 200 ords & fig.)

1933 62. (01 & 669 .1
ngineering, No. 3524, July 28, p. 75.
GOUGH (H. J.) & SOPWITH (D. G.). — Some mparative corrosion-fatigue tests employing two pes of stressing action. (3 300 words, tables & fig.)

1933 621 .43 (.42)
Engineering, No. 3524, July 28, p. 86.
270-H. P. heavy-oil locomotive. (900 words & fig.)

1933 625 .1 (.42)
Engineering, No. 3524, July 28, p. 97.
Widening work on the London and North Eastern Railway. (1 700 words & fig.)

1933 621 .392
Engineering, No. 3524, July 28, p. 102.
Two-wheeled portable electric welding plant. (500 words & fig.)

1933 698
Engineering, No. 3524, July 28, p. 104.
Pneumatic paint brush. (1 000 words & fig.)

Engineering News-Record. (New York.)

1933 621 .133.7 (.73) & 725 .33 (.73)
Engineering News-Record, No. 23, June 8, p. 733.
Progress in water supply. — A series of 10 articles on the various aspects of water supply progress. (35 000 words & fig.)

1933 624. (0
Engineering News-Record, No. 24, June 15, p. 771.
KOENITZER (L. H.). — Specifications suggested for asphalt bridge plank. (2 900 words & fig.)

1933 625 .13 (.73)
Engineering News-Record, No. 24, June 15, p. 775.
TAYLOR (G. B.). — Rolling a 400-ton railway span into position from falsework. (1 000 words & fig.)

1933 625 .13 (.493)
Engineering News-Record, No. 26, June 29, p. 827.
THORESEN (S. A.). — Shield-driven tunnels near completion under the Schelde at Antwerp, Belgium. (3 400 words & fig.)

1933 624 .2
Engineering News-Record, No. 26, June 29, p. 843.
ODD (A.). — Continuous beam design by the fixed point theory. — Graphical method permits easy construction of moment diagrams for any sequence of span lengths or any condition of loading. (1700 words & fig.)

1933 691
Engineering News-Record, No. 1, July 6, p. 11.
ACKERMANN (A. J.). — Demoistured air aids Madden dam cement. (1 700 words & fig.)

1933 62. (01 (06 (.73)
Engineering News-Record, No. 1, July 6, p. 18.
Many new specifications adopted at the American Society for Testing Materials meeting, Chicago, June 26-30, 1933. (2 700 words.)

1933 **624 (06 (.73)**

Engineering News-Record, No. 1, July 6, p. 20.

Civil engineers join in « **Engineering Week** ». (2 100 words.)

1933 **62. (01 (06 (.73)**

Engineering News-Record, No. 2, July 13, p. 49.

Materials and specifications discussed by the **American Society for Testing Materials**, Chicago, June 26-30, 1933. (2 500 words.)

1933 **624 (06 (.73)**

Engineering News-Record, No. 2, July 13, p. 51.

Technical discussions at **Civil Engineers' Convention.** (3 400 words.)

1933 **625 .13 (.73)**

Engineering News-Record, No. 3, July 20, p. 76.

MOORE (Ch. S.). — **Driving a 4 230-ft. tunnel** in Josemite National Park. (2 400 words & fig.)

Indian Railway Gazette. (Calcutta.)

1933 **656 .225 (.43)**

Indian Railway Gazette, March, p. 53.

STRAUSS (F.). — **The German State Railway Company.** (2 400 words.)

1933 **347 .763 (.42)**

Indian Railway Gazette, March, p. 118.

Modern railway practice and development. — **The road and rail traffic bill** in Great Britain. (2 500 words.)

Journal, Institution of Engineers, Australia. (Sydney.)

1933 **624 .2**

Journal, Institut. of Engineers, Australia, May, p. 145.

ROBIN (R. C.). — A graphical solution of **statically indeterminate frames.** (9 500 words, tables & fig.)

1933 **621 .392 (.944) & 624 (.944)**

Journal, Institut. of Engineers, Australia, May, p. 175.

COCKBURN (G. R.). — **Electric arc welding as applied to railway bridges.** With particular reference to the bridge over the Hunter River at Singleton, N. S. W. (1 000 words.)

Journal, Institute of Transport. (London.)

1933 **385. 1 (.42)**

Journal, Institute of Transport, July, p. 462.

FENELON (K. G.). — The present **economic position** of **British Railways.** (5 500 words & tables.)

1933 **621 .13, 621 .335 & 621 .43**

Journal, Institute of Transport, July, p. 472.

TRUTCH (C. J. H.) & BECKETT (C. M.). — Modern methods of **railway locomotion.** (16 000 words, tables & fig.)

1933 **656**

Journal, Institute of Transport, July, p. 496.

ROSS-JOHNSON (D.). — **The effect of rationalization and amalgamation on transport undertakings.** (2 600 words.)

1933 **656. 1**

Journal, Institute of Transport, July, p. 500.

OSLER (J. B.). — The future development of **road transport.** (4 000 words.)

1933 **659**

Journal, Institute of Transport, July, p. 507.

PIKE (J.). — **Transport advertising.** (3 200 words.)

Modern Transport. (London.)

1933 **656 .253 (.41) & 656 .257 (.41)**

Modern Transport, No. 745, June 24, p. 3.

Further **power signalling** innovation on L. M. S. R. (3 200 words & fig.)

1933 **625 .174 (.436)**

Modern Transport, No. 745, June 24, p. 6.

New **snow plough.** (600 words & fig.)

1933 **621 .132.8 (.54) & 656 .2 (.54)**

Modern Transport, No. 745, June 24, p. 9.

TRITTON (Sir S. B.). — The transport problem in India. **Light power rail units.** (2 800 words.)

1933 **625 .151 (.42)**

Modern Transport, No. 745, June 24, p. 10.

Railway point lever mechanism. Three-way indicator. (500 words & fig.)

1933 **625 .253**

Modern Transport, No. 745, June 24, p. 11.

STRAUSS (F.). — **Brakes for goods trains.** The Hardy system. (1 200 words & fig.)

1933 **625 .62 (.42)**

Modern Transport, No. 745, June 24, p. 13.

New **tramcar** for Blackpool. (1 700 words & fig.)

1933 **656 .1 (.494) & 656 .2 (.494)**

Modern Transport, No. 745, June 24, p. 18.

Railways and roads in Switzerland. New system of **co-ordination.** (1 300 words & fig.)

1933 **347 .763 (.42) & 656 (.42)**

Modern Transport, No. 745, June 24, p. 19.

HURCOMB (Sir C. W.). — **Public service passenger transport. Effects of the Road Traffic Act.** (2 400 words.)

1933 **621 .132.3 (.42)**

Modern Transport, No. 746, July 1, p. 3.

Superheated 4-6-2 four-cylinder « Pacifics », L.M.S.R. (800 words & fig.)

1933 621 .43
Modern Transport, No. 746, July 1, p. 5.
A British Diesel-electric railbus for high-speed local services. (1 500 words & fig.)

1933 621 .43 (.82)
Modern Transport, No. 747, July 8, p. 3.
Rail-car developments in Argentina. Further petrol-engined unit. (1 500 words & fig.)

1933 621 .33 (.41)
Modern Transport, No. 747, July 8, p. 5.
FAY (I. M.). — Railway electrification. Potentialities of the Drumm battery. (2 100 words.)

1933 621 .335 (.42) & 621 .43 (.42)
Modern Transport, No. 747, July 8, p. 6.
Diesel-electric traction. Observations on British practice. (1 500 words.)

1933 388
Modern Transport, No. 747, July 8, p. 7.
Urban and suburban passenger traffic. Modern operating methods. (1 700 words.)

1933 621 .138.1 (.42)
Modern Transport, No. 747, July 8, p. 9.
Economies at locomotive depots. Pneumatic ash extraction plant on L. M. S. R. (700 words & fig.)

1933 656 .211.7
Modern Transport, No. 748, July 15, p. 3.
Cross-Channel train ferry service (Dover-Dunkirk.) (700 words & fig.)

1933 621 .43 (.42)
Modern Transport, No. 748, July 15, p. 5.
A. E. C. build oil-engined railcar. (1 800 words & fig.)

1933 621 .335 (.43)
Modern Transport, No. 748, July 15, p. 8.
Oil-electric railcars on the Continent. (700 words & fig.)

1933 385 .3 (.73)
Modern Transport, No. 749, July 22, p. 2.
U. S. A. Railroad Administration. (900 words.)

1933 627 (.42) & 656 .213 (.42)
Modern Transport, No. 749, July 22, p. 4.
Development of the Port of Southampton. Completion of World's largest graving dock. (3 300 words & fig.)

1933 625 .1 (.42)
Modern Transport, No. 749, July 22, p. 7.
Widening of the York-Northallerton line. (2 200 words & fig.)

1933 656 (.42)
Modern Transport, No. 749, July 22, p. 9.
HACKING (A.). — National scheme for transport. No. 1. — Pooling of road and rail revenues (2 500 words.)

1933 621 .132.3 (.41)
Modern Transport, No. 749, July 22, p. 11.
Locomotives for Northern Counties Committee built at L. M. S. Derby Works. (1 000 words & fig.)

1933 385 .21 (.42)
Modern Transport, No. 750, July 29, p. 3.
Future of inland water transport. Rail and canal coordination. (2 100 words.)

1933 656 (.42)
Modern Transport, No. 750, July 29, p. 4.
HACKING (A.). — National scheme for transport. No. 2. — The financial aspect. (2 200 words.)

1933 625 .232 (.42)
Modern Transport, No. 750, July 29, p. 5.
Newly-designed trains of articulated open saloons and buffet cars. (1 400 words & fig.)

1933 656 .257 (.42)
Modern Transport, No. 750, July 29, p. 7.
Power signalling on the Great Western Railway. New installation at Cardiff station. (1 500 words & fig.)

1933 621 .392 (.42) & 625 .246 (.42)
Modern Transport, No. 750, July 29, p. 9.
Welded underframes for goods wagons. Egyptian State Railways experiment. (700 words & fig.)

Proceedings, American Railway Association (Signal Section). (New York.)

1933 656 .25 (06 (.73)
Proceed., Amer. Ry. Asson, Signal Section, May, p. 333.
Minutes of the thirty-ninth annual meeting, New York, N. Y., May 9 and 10, 1933.

Proceedings, Institution of Mechanical Engineers. (London.)

1932 621 .43
Proceed., Institution of Mechan. Eng., December, p. 349.
MUCKLOW (G. F.). — Piston temperatures in a solid-injection oil-engine. (7 000 words & fig.)

1932 621 .43
Proceed., Institution of Mechan. Eng., December, p. 373.
MUCKLOW (G. F.). — Experiments with a supercharged single-cylinder high-speed petrol-engine. (35 000 words & fig.)

1932 62. (01 & 669 .1

Proceed., Institution of Mechan. Eng., December, p. 479.

DOREY (S. F.). — **Elastic hysteresis in crankshaft steels.** (20 000 words & fig.)

1932 621 .6

Proceed., Institution of Mechan. Eng., December, p. 621.

SHERWELL (T. Y.) & PENNINGTON (R.). — **Centrifugal pump characteristics:** performance, construction, and cost. (17 000 words & fig.)

1932 621 .9 & 669 .1

Proceed., Institution of Mechan. Eng., December, p. 709.

SMITH (D.) & NIELD (A.). — Cutting tools Research Committee. Report on the **heat conductivity and hardness of carbon and high-speed steel,** also the durability of these steels when cutting brass. (5 000 words.)

1932 621 .18 & 621 .39

Proceed., Amer. Soc. of Mechan. Eng., December, p. 745.

THORNTON (B. M.) & THORNTON (W. M.). — **An electro-magnetic method of measuring the tickness of boiler tubes in situ.** (5 200 words & fig.)

1933 62. (01 & 669 .1

Proceed., Amer. Soc. of Mechan. Eng., December, p. 773.

HATFIELD (W. H.). — The **strength and behaviour of steels at high temperatures.** (3 600 words & fig.)

1933 621. 165

Proceed., Amer. Soc. of Mechan. Eng., December, p. 793.

CLAGNE (A. R.). — The **testing of steam-turbine generating sets.** (3 500 words & fig.)

1933 656 .213

Proceed., Amer. Soc. of Mechan. Eng., December, p. 805.

DYMOND (R. M.). — Some considerations affecting **dock equipment.** (5 000 words & fig.)

Railway Age. (New York.)

1933 385 .1 (.73) & 656 .23 (.73)

Railway Age, No. 23, June 10, p. 820.

Traffic recovery, the railways' greatest problem. (2 400 words & fig.)

1933 625 .232 (.73) & 625 .236 (.73)

Railway Age, No. 23, June 10, p. 823.

Pullman **all-aluminium compartment, observation-lounge car.** (1 800 words & fig.)

1933 725 .32 (.73)

Railway Age, No. 23, June 10, p. 831.

Designing **buildings for fruit and produce terminals.** (2 600 words & fig.)

1933 621 .132.5 (.73) & 621 .134.3 (.73)

Railway Age, No. 24, June 17, p. 854.

Delaware & Hudson develops fourth **high-pressure locomotive.** (2 800 words & fig.)

1933 624 .32 (.73)

Railway Age, No. 24, June 17, p. 858.

Louisville & Nashville builds new Tennessee **river bridge.** (2 500 words & fig.)

1933 656 .24 (06 (.73)

Railway Age, No. 24, June 17, p. 861.

Meeting of Freight Claim Division, A. R. A., held at Louisville. (3 600 words & fig.)

1933 347 .763.4 (.73) & 385 .3 (.73)

Railway Age, No. 24, June 17, p. 865.

LANE (H. F.). — **Congress passes railroad bill.** (5 500 words.)

1933 625 .234

Railway Age, No. 24, June 17, p. 869.

Air-conditioning requirements. (1 100 words.)

1933 656 .234 (.73)

Railway Age, No. 25, June 24, p. 884.

Will reductions in rates attract more passenger traffic? (3 800 words, 1 table & fig.)

1933 656 .2 (06 (.73)

Railway Age, No. 25, June 24, p. 889.

Superintendents meet at Cleveland. Two-day convention, held June 12-13, characterized by small attendance and year-old reports. (5 000 words.)

1933 62. (01 (.73) & 625 .143.4 (.73)

Railway Age, No. 25, June 24, p. 893.

TALBOT (A. N.). — **What happens when bolts are tight?** (2 300 words & fig.)

1933 621 .133.1 (.73)

Railway Age, No. 25, June 24, p. 897.

New fuel for rail motor cars. (1 000 words & fig.)

1933 621 .133.4

Railway Age, No. 25, June 24, p. 901.

Draft appliance reclaims cinders. (700 words & fig.)

1933 656 .1 (.73)

Railway Age, No. 25, June 24, p. 904.

Joint **service (of subsidiary motor coach lines)** proves satisfactory and economical. (2 300 words.)

1933 656 .261 (.73)

Railway Age, No. 25, June 24, p. 907.

Boston & Maine **truck operations** continue profitable. (1 800 words.)

1933 385 (.73) & 385. (061.4 (.73)

Railway Age, No. 1, July 1, p. 1.

Special number including a series of articles on **Railroad Research and Development and Abstracts of the reports presented** at the session held on the 26 June 1933 (Chicago) by the **Railroad Division of the American Society of Mechanical Engineers.**

1933 656 .23 (.73)
Railway Age, No. 2, July 8, p. 80.
What results from fare reductions? (3 200 words.)

1933 627 (.73) & 656 .213 (.73)
Railway Age, No. 2, July 8, p. 82.
New type deck used on Reading Pier. (900 words & fig.)

1933 621 .133.2 (.73) & 621 .133.4 (.73)
Railway Age, No. 2, July 8, p. 85.
Wabash tests effect of front end and grate design. (2 200 words, tables & fig.)

1933 62. (01 (06 (.73)
Railway Age, No. 2, July 8, p. 89.
American Society for Testing Materials has busy week at Chicago. (2 300 words.)

1933 625 .236 (.73)
Railway Age, No. 2, July 8, p. 90.
A safe car fumigator. (700 words & fig.)

1933 656 .254 (.73)
Railway Age, No. 2, July 8, p. 92.
Centralized traffic control on P. R. R. (1 000 words & fig.)

1933 621 .134 & 621 .137.1
Railway Age, No. 3, July 15, p. 111.
DAVIDSON (J. L.). — Scientific cut-off improves locomotive performance. (3 600 words, tables & fig.)

1933 385 .3 (.73) & 385 .4 (.73)
Railway Age, No. 3, July 15, p. 117.
Co-ordinator organizes for work. (3 400 words.)

1933 621 .392 (.73) & 625 .13 (.73)
Railway Age, No. 3, July 15, p. 122.
Repairing bridges with wrought iron plates. (1 000 words, tables & fig.)

1933 656 .254 (.73)
Railway Age, No. 3, July 15, p. 124.
New centralized traffic control on the Boston & Maine. (1 400 words.)

1933 625 .143.1 (.73)
Railway Age, No. 3, July 15, p. 126.
A. R. E. A. proposes 112-lb. rail section. (600 words & fig.)

1933 385 .52 (.73) & 385 .581 (.73)
Railway Age, No. 3, July 15, p. 127.
Kansas City Southern proposes new wage plan. (6 900 words.)

Railway Engineer. (London.)

1933 621 .138.5 (.42)
Railway Engineer, July, p. 193 & 199.
Stratford works reorganised, L. N. E. R. (3 200 words & fig.)

1933 621 .134.2 & 621 .134.3
Railway Engineer, July, p. 194.
Poppet or piston valves? (1 000 words.)

1933 621 .335 (.489) & 621 .43 (.489)
Railway Engineer, July, p. 195.
Diesel-electric locomotives for Danish private railways. (1 800 words & fig.)

1933 624 .63 (.41)
Railway Engineer, July, p. 209.
Concrete bridge construction in Northern Ireland. (3 400 words & fig.)

1933 621 .392 (.42) & 625 .15 (.42)
Railway Engineer, July, p. 217.
Repairing crossings by welding. (2 000 words & fig.)

1933 621 .39 & 669
Railway Engineer, July, p. 219.
BYRNE (B. R.). — Possibilities of the electric furnace in the foundry — III. (3 000 words & fig.)

Railway Engineering and Maintenance. (Chicago.)

1933 625 .142.2 (.73)
Railway Engineering and Maintenance, July, p. 320.
CURTIS (D. C.). — Preparing a crosstie program. (3 400 words, tables & fig.)

1933 621 .392 (.73) & 625 .13 (.73)
Railway Engineering and Maintenance, July, p. 323.
ROOF (W. R.). — Fighting corrosion in bridge maintenance. (1 400 words & fig.)

1933 625 .143.4 (.73) & 625 .172 (.73)
Railway Engineering and Maintenance, July, p. 326.
Evening up rail ends by grinding. (1 300 words & fig.)

1933 621 .337 (.73)
Railway Engineering and Maintenance, July, p. 328.
Modernizing water facilities. (4 000 words & fig.)

Railway Gazette. (London.)

1933 625 .143.4 (.945) & 665 .882 (.945)
Railway Gazette, No. 25, June 23, p. 839.
Long welded rails on the Victorian Railways. (1 200 words & fig.)

1933 621 .132.3 (.42)
Railway Gazette, No. 26, June 30, p. 860, 873.
The new L. M. S. express engine. (2 900 words.)

1933 **621 .136.2 & 625 .216**
Railway Gazette, No. 26, June 30, p. 866.
A new **articulated drawbar.** (500 words & fig.)

1933 **656 .253 (.42)**
Railway Gazette, No. 26, June 30, p. 867.
Power signalling at Cardiff, G. W. R. (2 700 words & fig.)

1933 **621 .43 (.42), 656 .1 (.42) & 656 .261 (.42)**
Railway Gazette, No. 26, June 30, p. 882.
The **Southern Railway and road transport.** (2 600 words & fig.)

1933 **656 .211.3 (.42) & 725 .3 (.42)**
Railway Gazette, No. 1, July 7, p. 11.
New **Central Station** at Exeter, Southern Railway. (1 200 words & fig.)

1933 **621 .132.6 (.73)**
Railway Gazette, No. 1, July 7, p. 16.
A proposed American **tank locomotive.** (300 words & fig.)

1933 **621 .132.3 (.43) & 621 .133.3 (.43)**
Railway Gazette, No. 1, July 7, p. 17.
Special-steel boilers in Germany. (650 words & fig.)

1933 **621 .33 (.439)**
Railway Gazette, No. 1, July 7, p. 18.
Hungarian **main-line electrification.** (900 words & fig.)

1933 **621 .132.3 (.44)**
Railway Gazette, No. 2, July 14, p. 48.
Paris-Orleans **Pacific rebuilt as 4-8-0 express locomotive.** (1 400 words & fig.)

1933 **621 .94 (.42)**
Railway Gazette, No. 2, July 14, p. 50.
A new Muir **milling machine.** (400 words & fig.)

1933 **656 .215 (.68)**
Railway Gazette, No. 2, July 14, p. 51.
Lighting scheme at new Johannesburg **railway station.** (500 words & fig.)

1933 **621 .33 (.493)**
Railway Gazette, No. 2, July 14, p. 52.
Electrification of a Brussels **suburban line.** (700 words & fig.)

1933 **621 .133.3**
Railway Gazette, No. 3, July 21, p. 98.
Useful limit to **superheating.** (800 words.)

1933 **625 .232 (.42)**
Railway Gazette, No. 3, July 21, p. 98.
Rebuilt composite Pullman cars. (250 words.)

1933 **621 .132.3 (.62)**
Railway Gazette, No. 3, July 21, p. 100.
Rebuilt Egyptian Express locomotive. (500 words & fig.)

1933 **625 .1 (.42)**
Railway Gazette, No. 3, July 21, p. 101.
London & North Eastern Railway **main line widening.** (1 700 words & fig.)

1933 **621 .132.3 (.41)**
Railway Gazette, No. 3, July 14, p. 104.
New 2-6-0 locomotives L. M. S. R. (N. C. C.), **Ireland.** (300 words & fig.)

1933 **656 .215 (.42)**
Railway Gazette, No. 4, July 28, p. 129.
Goods depot lighting, Southern Railway. (800 words & fig.)

1933 **627 (.42) & 656 .213 (.42)**
Railway Gazette, No. 4, July 28, p. 131.
Southern Railway's Southampton **Docks extension** and world's largest **graving dock.** (1 500 words & fig.)

1933 **625 .232 (.42)**
Railway Gazette, No. 4, July 28, p. 140.
New **tourist trains,** London & North Eastern **Ry.** (1 400 words & fig.)

1933 **621 .33 (.43) & 656 .222.1 (.43)**
Railway Gazette, No. 4, July 28, p. 145.
High-speed German electric train trials. (600 words & fig.)

1933 **656 .1 & 657**
Railway Gazette, No. 4, July 28, p. 147.
Road motor accounts for colonial railways. (1 700 words.)

1933 **621 (06 (.485) & 621 .43 (.485)**
Diesel Railway Traction, Supplement to the Railway Gazette, July 14, p. 71.
Diesel traction at the World Power Conference. (1 800 words.)

1933 **621 .43 (.489)**
Diesel Railway Traction, Supplement to the Railway Gazette, July 14, p. 73.
Frichs **Diesel-mechanical railcar.** (750 words & fig.)

1933 **621 .43 (.4)**
Diesel Railway Traction, Supplement to the Railway Gazette, July 14, p. 75.
BRIAN REED. — Development of **Diesel traction.** — III. — **Railcars in Europe.** (2 000 words & fig.)

1933 **621 .43 (.43)**
Diesel Railway Traction, Supplement to the Railway Gazette, July 14, p. 78.
A. E. C. **Diesel-engined railcar.** (3 200 words.)

1933 **621 .335 (.489) & 621 .43 (.489)**
Diesel Railway Traction, Supplement to the Railway Gazette, July 14, p. 82.
High-speed Diesel-electric railcars for Denmark. (600 words & fig.)

1933 **621 .43 (.8)**
Diesel Railway Traction, Supplement to the Railway Gazette, July 14, p. 83.
South American **Diesel railcar.** (900 words & fig.)

1933 **621 .43 (.43)**
Diesel Railway Traction, Supplement to the Railway Gazette, July 14, p. 85.
Benes **fuel-injection pump.** (700 words & fig.)

Railway Magazine. (London.)

1933 **625 .4 (.42)**
Railway Magazine, July, p. 17.
NOCK (O. S.). — **London's « Underground »** — its rise and progress. (4 700 words & fig.)

1933 **656 .222.1 (.52)**
Railway Magazine, July, p. 41.
MOTODIMA (S.). — **Modern express services** in **Japan.** (1 800 words & fig.)

Railway Mechanical Engineer. (New York.)

1933 **625 .232 (.73) & 625 .235 (.73)**
Railway Mechanical Engineer, June, p. 185.
Two **aluminium passenger cars** on exhibit at Chicago. (4 500 words & fig.)

1933 **621 .132.5 (.73) & 621 .134.3 (.73)**
Railway Mechanical Engineer, June, p. 193.
Delaware & Hudson develops **triple-expansion locomotive.** (4 300 words, tables & fig.)

1933 **621 .133.8 (.73)**
Railway Mechanical Engineer, June, p. 203.
Barco **ball-check reverse-gear joint.** (350 words & fig.)

1933 **621 .131.2 (.71)**
Railway Mechanical Engineer, June, p. 204.
GREEN (J. J.). — **Wind tunnel tests of locomotive streamlining.** Part II. — (2 500 words & fig.)

1933 **385. (061.4**
Railway Mechanical Engineer, July, p. 233.
Mechanical Division, A. R. A., Standing Committee present reports at open session, 27 June 1933. Abstracts of 15 reports on the following subjects: **Automotive train-line connectors; Automotive rolling-stock; Arbitration Committee; Brakes and brake equipement; car construction; Couplers and draft gears; Loading rules; Locomotive and car lighting Locomotive construction; Lubrication of cars and locomotives; Prices for labor and materials; Tank cars; Material specifications; Wheels; Electric rolling stock.**

1933 **625 .216**
Railway Mechanical Engineer, July, p. 253.
ENDSLEY (L. E.). — **Draft gear springs** — Past and present. (2 500 words & fig.)

1933 **625 .24 (0**
Railway Mechanical Engineer, July, p. 255.
BARTHELEMY (P. P.). — **Tendencies in freight car design.** (2 200 words.)

Railway Signaling. (Chicago.)

1933 **656 .254 (.73)**
Railway Signaling, July, p. 179.
Centralized Traffic Control on the Boston & Maine. (2 500 words & fig.)

1933 **625 .151 (.73)**
Railway Signaling, July, p. 183.
DICKINSON (B. F.). — **Spring switch with lock.** (1 500 words & fig.)

1933 **656 .256.3 (.73)**
Railway Signaling, July, p. 185.
Signaling on the Maine Central. (2 000 words, tables & fig.)

1933 **656 .257 (.73)**
Railway Signaling, July, p. 189.
Union Railroad Company installs **large electro-pneumatic.** (2 400 words & fig.)

1933 **625 .162 (.73) & 656 .259 (.73)**
Railway Signaling, July, p. 193.
Crossing gates replaced by **flashing light signals.** (1 900 words & fig.)

1933 **656 .257 (.73)**
Railway Signaling, July, p. 195.
BENDER (F. W.). — **Remotely controlled interlocking** on the Central of New Jersey. (900 words & fig.)

The Locomotive. (London.)

1933 **621 .132.3 (.42)**
The Locomotive, July 15, p. 197.
New **4-6-2 « Pacific » type four-cylinder locomotive,** L. M. S. Ry. (1 400 words & fig.)

1933 **621 .131.3 (.44)**
The Locomotive, July 15, p. 201.
New **dynamometer cars,** French State Railways. (900 words & fig.)

1933 **621 .335 (.43) & 621 .43 (.43)**
The Locomotive, July 15, p. 209.
150 B. H. P. **petrol-electric rail motor car.** (800 words & fig.)

1933 621 .335 (.42) & 621 .43 (.42)
The Locomotive, July 15, p. 217.
Armstrong-Whitworth **Diesel-electric railbus.** (2 000 words & fig.)

1933 625 .212 (.42)
The Locomotive, July 15, p. 221.
The Gloucester **welded wheel and axle set.** (300 words & fig.)

1933 621 .43 (.44)
The Locomotive, July 15, p. 222.
Hich-speed pneumatic tyred rail-car. (600 words & fig.)

1933 621 .132.3 (.47)
The Locomotive, July 15, p. 223.
BEZPYATKIN (W. I.). — **Pacific express locomotive** for the Vladikavkas Ry., Russia. (1 000 words & fig.)

Transit Journal. (New York.)

1933 621 .392 (.73) & 625 .143.4 (.73)
Transit Journal, June, p. 186.
WALKER (F. B.). — **Welding joints in open track.** (800 words & fig.)

1933 621 .338 (.73)
Transit Journal, June, p. 205.
Notable **innovations** in **Presidents' conference car.** (3 800 words & fig.)

1933 621 .335 (.73) & 656 .1 (.73)
Transit Journal, June, p. 212.
Trolley buses at Dayton attract more passengers. (800 words & fig.)

1933 621 .332 (.73)
Transit Journal, June, p. 213.
COX (J. H.). — **Sectional mercury arc rectifier** proves satisfactory. (1 200 words & fig.)

University of Illinois Bulletin (Urbana, Ill.)

1933 62. (01 & 721 .3
University of Illinois Bulletin, No. 255, 28 February, p. 5.
WILSON (W. M.) & NEWMARK (N. M.). — The **strength of thin cylindrical shells as columns.** (8 400 words, tables & fig.)

In Bulgarian.

(= 91.881)

Spisanie. (Sofia.)

1931 656 .253 (.497.2) = 91 .881
Spisanie, Nos. 3/4, p. 90.
VLAJKOV. — **Electric power signalling** in Svogué station. (7 pages & fig.)

1931 625 .13 = 91 .881
Spisanie, Nos. 5/6, p. 175.
KJUCIKOV. — The **rounding-off** of changes of **railway gradients.** (8 pages & fig.)

1931 625 .1 (.497.2) = 91 .881
Spisanie, No. 7, p. 287.
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SUPINO (G.). — Sopra l'influenza del peso proprio nella flessione e pressoflessione di una trave verticale. (500 parole).

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In Portuguese.

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P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

OCTOBER (1933)

[016 .385. (02]

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Paris (6e), Ch. Béranger, 15, rue des Saints-Pères & Liége, 1, quai de la Grande-Bretagne. 1 volume, 432 pages et 443 figures. (Prix : 60 fr. français.)

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Les méthodes d'étude des alliages métalliques.
Paris, Dunod. Un volume, 860 pages et 998 figures. (Prix: 192 fr. français.)

1933 624 .92
LABARRAQUE (P.).
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Paris, J. B. Baillière et fils. 1 volume, 410 pages et 395 figures. (Prix: 28 fr. français.)

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Lille, Société industrielle du Nord de la France. 1 brochure, 19 pages et 1 carte.

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POUILLOT (A.).
Précis de résistance des matériaux appliquée aux machines.
Paris (5e), Léon Eyrolles, 3, rue Thénard. 1 volume (16.5×25), 216 pages et 102 figures. (Prix: 25 fr. français.)

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Problèmes de résistance des matériaux.
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A survey of 21 experts of the work and the relations of one of the three permanent international agencies established under the Treaty of Versailles.

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1933 **624 .5 (44)**

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SPIESS (E.). **Automotrices Diesel.** (6 000 mots & fig.)

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TOURNEUR. — Essais de **locomotives Diesel-électriques de manœuvres** sur le réseau P. L. M. (5 700 mots & fig.)

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Die Reichsbahn, Nr. 23, S. 485.

PAETZOLT. — **Flugeisenbahn—Güterverkehr** zwischen Belgien und der Tchechoslowakei im Durchgang durch Deutschland. (3 1/4 Seiten.)

1933 **656 .212.7 (.43)**

Die Reichsbahn, Nr. 25, S. 532.

TECKLENBURG. — **Überladebrücken** an Güterschuppen. (7 1/2 Seiten, Zeichn. & Abb.)

1933 **625 .245 & 656 .225**

Die Reichsbahn.

CULEMEYER. — Das **Strassenfahrzeug** für Eisenbahnwagen. Eine Verkehrsaufgabe und ihre Lösung. (22 Seiten, Zeichn. & Abb.)

1933 **621 .43 (.43)**

Die Reichsbahn, Nr. 1, S. 7.

FUCHS. — Der **Schnelltriebwagen** der Deutschen Reichsbahn—Gesellschaft. (9 1/2 Seiten, Zeichn. & Abb.)

1933 **347 .763.4 (.43)**

Die Reichsbahn, Nr. 2, S. 27.

KITTEL. — Die Deutsche Reichsbahn—Gesellschaft in ihren Beziehungen zum **öffentlichen Recht.** (5 Seiten.)

1933 **385 .1 (.43)**

Die Reichsbahn, Nr. 4, S. 66.

RÖHE. — **Buchungsgrundsätze** und Bilanz der deutschen Reichsbahn. Vortrag, gehalten im Institut für Wirtschaftswissenschaft, Frankfurt a. Mein am 19. Januar 1933. (14 1/2 Seiten & Tafeln.)

1933 **656 .1 (.497.1)**

Die Reichsbahn, Nr. 5, S. 95.

Kraftverkehrsrecht in Jugoslawien. (2 Seiten.)

1933 **656 .225**

Die Reichsbahn, Nr. 7, S. 131.

MEYER. — **Frachtstückgut—Schnellverkehr.** — Neue Wege. (3 Seiten.)

1933 **656**

Die Reichsbahn, Nr. 9, S. 166.

HESSE. — Das Produktivitätsproblem im **Verkehrswesen.** (4 1/4 Seiten.)

Glasers Annalen. (Berlin.)

1933 **621 .392**

Glasers Annalen, Heft 2, 15. Juli, S. 13.

ZIEM (H.). — Die Schrumpfspannungen in der Schweissnaht und ihr Einfluss auf die **Haltbarkeit geschweisster Konstruktionen.** (1 700 Wörter & Abb.)

1933 **385 .113 (.43)**

Glasers Annalen, Heft 3, 1. August, S. 17.

Aus dem **Geschäftsbericht** der Deutschen Reichsbahn-Gesellschaft über das 8. Geschäftsjahr. (4 000 Wörter.)

1933 **621 .87**

Glasers Annalen, Heft 3, 1. August, S. 22.

CORDTS. — **Krane und Hebezeuge** in neuer Zeit. (1 700 Wörter & Abb.)

Organ für die Fortschritte des Eisenbahnwesens. (Berlin.)

1933 **656 .257 (.43)**

Organ für die Fortschritte des Eisenbahnwesens, Heft 15, 1. August, S. 289.

FATKEN. — Das neue **Reiterstellwerk** auf Bahnhof Stendal. (3 300 Wörter & Abb.)

1933 **625 .14 (01**

Organ für die Fortschritte des Eisenbahnwesens, Heft 15, 1. August, S. 303.

Bahnunterbau, Brücken und Tunnel; **Bahnoberbau.** (700 Wörter & Abb.)

1933 **621 .33 (.43)**

Organ für die Fortschritte des Eisenbahnwesens, Heft 15, 1. August, S. 304.

Elektrisierung der Fernbahn Augsburg—Stuttgart und der Stuttgarter Vorortlinien. (1 000 Wörter & Abb.)

1933 **621 .138.3 (.43), 621 .138.5 (.43) & 625 .26 (.43)**

Organ für die Fortschritte des Eisenbahnwesens, Heft 16, 15. August, S. 307.

GREHLING. — Plan und Wirtschaft in der **Fahrzeugunterhaltung.** Entwicklung bei der Eisenbahndirektion des Saargebietes. (5 400 Wörter & Abb.)

1933 **621 .135.2 & 625 .212**

Organ für die Fortschritte des Eisenbahnwesens, Heft 16, 15. August, S. 315.

HEFFT (O.). — Feinstbearbeitung der **Lager, Zapfen und Achsschenkel.** (1 300 Wörter & Abb.)

1933 **621 .135.2 & 625 .212**

Organ für die Fortschritte des Eisenbahnwesens, Heft 16, S. 317.

RUMMEL (A.). — Einrichtungen zum **Ziehschleifen** von **Zapfen** und **Achsschenkeln.** (1 900 Wörter & Abb.)

1933 **621 .133.7**

Organ für die Fortschritte des Eisenbahnwesens, Heft 16, S. 320.

RECK. — Versuche über die Wirkung eines **Kesselsteingegenmittels.** (1 200 Wörter & Abb.)

Verkehrstechnische Woche. (Berlin.)

1933 **621 .33 (.431)**

Verkehrstechnische Woche, Nr. 1, S. 1; Nr. 2, S. 14; Nr. 3, S. 33.

REMY. — Die **Elektrisierung** der Wannseebahn in ihrer baulichen, wirtschaftlichen und städtebaulichen Bedeutung. (23 Seiten, Zeichn., Diagr. & Abb.)

1933 **656 .1 (.43) & 656 .2 (.43)**

Verkehrstechnische Woche, Nr. 4, S. 41.

STEUERNAGEL. — Die **Vorhaltungskosten** von Schienenweg und Landstrasse. Eine zahlenmässiger Vergleich des Aufwandes der Volkswirtschaft für die Fahrbahn der beiden Transport-systeme. (2 Seiten.)

1933 **656**

Verkehrstechnische Woche, Nr 5, S. 53.

KIENITZ. — Der **Wettbewerb** in der Verkehrswirtschaft. Vortrag, gehalten im Verein für Eisenbahnkunde am 10. Januar 1933. (10 Seiten.)

1933 **621 .13 (.43) & 621 .43 (.43)**

Verkehrstechnische Woche, Nr. 5, S. 62.

SEMMLER. — Zur Gegenüberstellung von **Triebwagen** und **Dampfzügen** bei der Reichsbahn. (2 Seiten.)

1933 **656 (.43)**

Verkehrstechnische Woche, Nr. 6, S. 69.

MÜLLER. — Die Bedeutung der deutschen **Nahverkehrsmittel.** Vortrag, gehalten vor dem Verein für Eisenbahnkunde am 13. Dezember 1932. (8 1/2 Seiten.)

1933 **656 .1 & 656 .2**

Verkehrstechnische Woche, Nr. 7, S. 81.

JACOBI. — Die **Kosten** des **Wettbewerbsverkehrs** auf der Schiene. Ein Beitrag zur Frage des Wettbewerbs zwischen Eisenbahn und Kraftwagen. (4 1/2 Seiten.)

1933 **625 .245 (.73) & 656 .225 (.73)**

Verkehrstechnische Woche, Nr. 7, S. 85; Nr. 8, S. 100; Nr. 9, S. 109; Nr. 10, S. 125.

Entwicklung des **Behälter-Verkehrs** auf Amerikanischen Eisenbahnen. I. Die Stückgutfracht-Behälter. II. Behälter für Wagenladungsgüter in loser Schüttung. (Container for Bulk Freight). III. Die Untersuchung durch das Bundesverkehrsamt. (Interstate Commerce Commission) — Entscheidung des U. S. Bundesverkehrsamtes über die Regelung des Behälter-Verkehrs auf den amerikanischen Eisenbahnen. — Verkehrsbrief aus den Beweisunterlagen für und wider den Behälter-Dienst. — Gesetzmässigkeit der Frachttraten. Sondertypen von Behältern. Schlussfolgerungen. (15 1/2 Seiten.)

1933 **656 .1 & 656 .2**

Verkehrstechnische Woche, Nr. 9, S. 105.

TECKLENBURG. — **Kraftwagen-Eisenbahn.** Gegenüberstellung der Selbskosten beider Verkehrsunternehmen. (4 Seiten.)

1933 **656 .1 (.45) & 656 .2 (.45)**

Verkehrstechnische Woche, Nr. 11, S. 133.

BECKER. — **Kraftwagen** und **Eisenbahn** in Italien. (6 Seiten.)

1933 **625 .258**

Verkehrstechnische Woche, Nr. 13, S. 161.

MÖNCH. — Kosten der **Hemmschuhbremsung,** der **Gleisunterhaltung** und **Auswechslung** auf Verschiebebahnhöfen. (4 Seiten & Zeichn.)

1933 **625 .11**

Verkehrstechnische Woche, Nr. 14, S. 173.

GRABIG. — Schlanke **Linienführung** der durchgehenden Hauptgleise auf den Zwischenbahnhöfen. (2 Seiten, Zeichn. & Abb.)

1933 **621 .43**

Verkehrstechnische Woche, Nr. 14, S. 177.

WOHLLEBE. — Der gegenwärtige Stand des **Diesellokomotivbaues.** (3 1/2 Seiten & Abb.)

Zeitschrift des Vereines Deutscher Ingenieure. (Berlin.)

1933 **691 & 62. (01**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 30, 29. Juli, S. 813.

GRAF (O.). — Aus Untersuchungen mit **Zement, Zementmörtel** und **Beton.** (6 000 Wörter & Abb.)

1933 **621 .116**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 30, 29 Juli, S. 820.

JAKOB. — Neue Ergebnisse der ausländischen **Wasserdampfforschung.** (2 000 Wörter & Abb.)

1933 **624 .2**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 30, 29. Juli, S. 831.

Gegenwartsfragen der **Schwingungstechnik.** (2 300 Wörter.)

1933 **62. (01**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 31, 5. August, S. 851.

THUM (A.) & WUNDERLICH (F.). — Der Einfluss von Einspann- und Kraftangriffsstellen auf die **Dauerhaltbarkeit der Konstruktionen.** (2 000 Wörter & Abb.)

1933 **621 .3**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 31, 5. August, S. 856.

Über **metallische elektrische Widerstandsstoffe.** (2 100 Wörter & Abb.)

1933 **691**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 32, 12 August, S. 865.

SCHRÖTER (H.). — **Korrosion bei Kavitation.** Bericht über Versuche am **Walchenseekraftwerk.** (1 800 Wörter & Abb.)

1933 **625 .14 (01**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 32, 12. August, S. 873.

THOMA (H.). — Aufzeichnung der **Schienenbeanspruchung unter schnellfahrenden Zügen.** (3 200 Wörter & Abb.)

1933 **625 .13**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 33, 19. August, S. 905.

SICHARDT (W.). — Chemische Bodenverfestigung und -abdichtung im **Tunnelbau.** (2 400 Wörter & Abb.)

1933 **621 .43**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 33, 19. August, S. 908.

WENTZEL (W.). — Zur Berechnung der Verbrennungsvorgänge im **Verbrennungsmotor.** (1 400 Wörter.)

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen. (Berlin.)

1933 **656 .212.5**

Zeitsch. für das gesamte Eisenb.-Sicherungsw., Nr. 10, 1. August, S. 109.

WAGNER (Th.). — Neuzeitliche Entwicklung der **Ablaufstellwerke.** (1 600 Wörter & Abb.)

1933 **656 .259**

Zeitsch. für das gesamte Eisenb.-Sicherungsw., Nr. 10, 1. August, S. 117.

GLÄSEL. — Über Nebenantriebe an **Signalen.** (1 100 Wörter & Abb.)

Zeitung des Vereins mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

1933 **656 .1 (.43)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 29, 20. Juli, S. 597.

Reichsautobahnen. (1 400 Wörter.)

1933 **656 .237 (.43)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 29, 20. Juli, S. 599.

BUSCH. — Die Auswertung der **Abrechnung unter den Reichsbahnbezirken.** (6 000 Wörter.)

1933 **385. (01 (.6)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 30, 27. Juli, S. 617.

BÄSELER. — Die **Wüstenbahn.** (1 200 Wörter & Abb.)

1933 **385 .4 (.42)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 30, 27. Juli, S. 624.

Die **englischen Eisenbahnen** im Jahre 1932. (3 500 Wörter.)

1933 **625 .245 (.43) & 656 .225 (.43)**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 32, 10. August, S. 653; Nr. 33, 17. August, S. 673.

BECKER. — Vier Jahre **Behälterverkehr** im **Reichsbahndirektionsbezirk Frankfurt** (Main). (9 000 Wörter & Abb.)

1933 **625 .143.2**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 33, 17. August, S. 665.

SPIES (R.). — **Schienen aus Verbundstahl.** (1 900 Wörter & Abb.)

1933 **625 .258**

Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 33, 17. August, S. 679.

BLOCH (A.). — Zur Verwendung des **Hemmschuhes** in Gleiskrümmungen. (1 400 Wörter & Abb.)

In English.

Engineer. (London.)

1933 625 .232 (.42)
Engineer, No. 4047, August 4, p. 112.
New L. N. E. Ry. trains for tourist traffic. (600 words & fig.)

1933 621 .134.3
Engineer, No. 4047, August 4, p. 115.
High-pressure locomotives. (1 200 words.)

1933 621 .43 (.73)
Engineer, No. 4047, August 4, p. 120.
Experimental rail-car. (300 words).

1933 0 & 65
Engineer, No. 4048, August 11, p. 130.
SIMONS (E. N.). — Organising an information service. (3 200 words.)

1933 621 .43
Engineer, No. 4048, August 11, p. 135.
PATERSON (R.). — High-speed oil engine design. (2 600 words, 7 tables & fig.)

1933 621 .9
Engineer, No. 4048, August 11, p. 142.
Improved wood-working machines. (900 words & fig.)

1933 625 .113
Engineer, No. 4049, August 18, p. 156.
BALL (J. D. W.). — Relining for transition curves by offsets. (1 200 words, 2 tables & fig.)

1933 624 .51 (.73)
Engineer, No. 4049, August 18, p. 164.
The Golden Gate bridge. (3 000 words & fig.)

1933 621 .91 (.42)
Engineer, No. 4049, August 18, p. 168.
Railway axle-box planing machine. (600 words & fig.)

1933 621 .43 (.42)
Engineer, No. 4049, August 18, p. 168.
Oil-electric rails-bus results. (200 words & fig.)

Engineering. (London.)

1933 621 .116 & 669 .1
Engineering, No. 3525, August 4, p. 108.
DICKIE (H. A.). — Embrittlement of steel at high steam temperatures. (2 700 words & fig.)

1933 625 .232 (.42)
Engineering, No. 3525, August 4, p. 114.
Tourist trains on the London and North-Eastern Ry. (900 words & fig.)

1933 621 .131.3 (.44)
Engineering, No. 3525, August 4, p. 124.
Locomotive-testing station at Vitry-sur-Seine, Paris. (2 700 words & fig.)

1933 62. (01
Engineering, No. 3525, August 4, p. 127.
The Rawson dial extensometer. (350 words & fig.)

1933 621 .133.1
Engineering, No. 3525, August 4, p. 128.
The cost of pulverising coal on land. (900 words & 1 table.)

1933 621 .5 (.42)
Engineering, No. 3525, August 4, p. 129.
Portable railway air-compressor set. (1 000 words & fig.)

1933 624 .2
Engineering, No. 3526, August 11, p. 133.
BALL (J. D. W.). — Revision of allowances for impact in railway underbridges. (1 300 words & fig.)

1933 536 & 621 .138.5
Engineering, No. 3526, August 11, p. 139.
Optical method of lining-up locomotive frames. (2 000 words & fig.)

1933 621 .335 (.42) & 621 .43 (.42)
Engineering, No. 3526, August 11, p. 152.
Diesel-electric streamlined rail coach. (1 000 words & fig.)

1933 62. (01 & 669 .1
Engineering, No. 3526, August 11, p. 154.
SELWYN CASWELL (J.). — The effect of surface finish on the fatigue limit of mild steel. (1 100 words & fig.)

1933 62. (01 & 624 .2
Engineering, No. 3527, August 18, p. 157.
HOLMSTROM (J. E.). — Checking the strength of bridge girders. (4 500 words & tables.)

1933 62. (01
Engineering, No. 3527, August 18, p. 161.
SARAN (W.). — The Schenck autographic extensometer. (1 800 words & fig.)

1933 01
Engineering, No. 3527, August 18, p. 173.
International indexing. (1 500 words.)

1933 621 .91
Engineering, No. 3527, August 18, p. 177.
Butler axle-box planer. (500 words.)

1933 656 .212.6 (.42)
Engineering, No. 3527, August 18, p. 178.
Anti-coal breaker for loading ships. (800 words & fig.)

Engineering News-Record. (New York.)

1933 **624 .2**
Engineering News-Record, No. 4, July 27, p. 95.
RYAN (W. J.) & SMITH (Wm. D.). — **Ring-connector joints used on timber bridge trusses.** (2 200 words & fig.)

1933 **624 .63 (.47)**
Engineering News-Record, No. 6, August 10, p. 160.
CHRISTENSEN (C. L.). — **Russia builds rail-bridge** over Dnieper River. (800 words & fig.)

1933 **621 .39 & 691**
Engineering News-Record, No. 6, August 10, p. 169.
SLACK (S. B.). — **Ohms of resistance measure concrete curing.** (900 words & fig.)

Journal of the Institution of Engineers, Australia. (Sydney.)

1933 **624 .2**
Journal, Institut. of Engineers, Australia, June, p. 181.
KOERNER (C. F.). — **The impact effect of live loads upon bridges.** (12 000 words & fig.)

The Locomotive. (London.)

1933 **621 .132.5 (.73) & 621 .134.3 (.73)**
The Locomotive, No. 492, August 15, p. 227.
4-8-o four-cylinder triple expansion locomotive, Delaware & Hudson R.R. (2 200 words & fig.)

1933 **621 .132.8 (.493)**
The Locomotive, No. 492, August 15, p. 230.
The « Franco » **articulated locomotive.** (1 500 words & fig.)

1933 **625 .232 (.43)**
The Locomotive, No. 492, August 15, p. 234.
New tourist trains, L. & N. E. Ry. (1 500 words & fig.)

1933 **621 .132.3 (.41)**
The Locomotive, No. 492, August 15, p. 237.
2-6-o locomotives for the L. M. S. Ry., Northern Counties Committee. (900 words & fig.)

1933 **621 .43 (.42)**
The Locomotive, No. 492, August 15, p. 238.
A. E. C. 130 H. P. **Diesel-engined rail-car.** (3 000 words & fig.)

1933 **621 .43 (.82)**
The Locomotive, No. 492, August 15, p. 246.
Petrol-engined bogie rail-car, Buenos Aires & Pacific Ry. (1 800 words & fig.)

Modern Transport. (London.)

1933 **656. 222 (.44)**
Modern Transport, No. 751, August 5, p. 3.
HEARN (Sir Gordon). — **The fight for railway revenue.** (1 200 words.)

1933 **621 .335**
Modern Transport, No. 751, August 5, p. 5.
RATCLIFFE (T.). — **The battery in modern locomotion.** (2 700 words & fig.)

1933 **385 .113 (.42)**
Modern Transport, No. 751, August 5, p. 7.
British railway results. (1 400 words.)

1933 **656 .212.5 (.43)**
Modern Transport, No. 752, August 12, p. 4.
Railway methods in Germany. No. 1. — **Marshalling yard practice.** (2 600 words.)

1933 **621 .335 (.42) & 621 .43 (.42)**
Modern Transport, No. 752, August 12, p. 6.
Diesel-electric rail-bus. Trial runs from King's Cross. (300 words & fig.)

1933 **621 .335 (.41)**
Modern Transport, No. 753, August 19, p. 3.
New Drumm **battery-driven train** on trial. (1 200 words & fig.)

1933 **621 .43**
Modern Transport, No. 753, August 19, p. 4.
Diesel engines for railcars and locomotives. — Two-stroke and four-stroke types. (900 words.)

1933 **656 .225 (.43)**
Modern Transport, No. 753, August 19, p. 5.
Railway methods in **Germany.** — No. 2 — **Conveyance of small consignments.** (1 800 words.)

Railway Age. (New York.)

1933 **625 .234 (.73)**
Railway Age, No. 4, July 22, p. 144.
Will air conditioning attract more passengers? Traffic development series. Article No. 4. (2 400 words & fig.)

1933 **691 (.73)**
Railway Age, No. 4, July 22, p. 147.
WOOLLEN (A. H.). — **Aluminium's tenth anniversary on the Railroads.** (2 600 words & fig.)

1933 **625 .143.3 (.73) & 625 .172 (.73)**
Railway Age, No. 4, July 22, p. 153.
TALBOT (A. N.). — **Better maintenance will reduce stresses in rail.** (2 000 words & fig.)

1933 **656. (02 (.73)**
Railway Age, No. 4, July 22, p. 157.
Railroad Superintendents meet at Cleveland, 12-13 June. Concluding reports (discuss faster l. c. l. service motor, competition and claim prevention). (5 000 words.)

1933 **656 .261 (.73)**
Railway Age, No. 4, July 22, p. 161.
Motor Transport Section (Railroad Superintendents Convention) **analyse results of pick-up and delivery service.** (3 200 words.)

1933 **625 .13 (.73) & 691 (.73)**
Railway Age, No. 6, August 5, p. 209.
Long precast bridge slabs carry tracks without ballast. (2 200 words & fig.)

1933 **625 .23 & 656 .2**
Railway Age, No. 6, August 5, p. 212.
Is modern **equipment** the answer ? Traffic development series. — Article No. 5. (3 300 words & fig.

1933 **385 .1 (.73)**
Railway Age, No. 6, August 5, p. 216.
LISMAN (F. J.). — **Railroads' public relations policies.** (3 700 words.)

1933 **621 .43 (.73)**
Railway Age, No. 6, August 5, p. 219.
Austro-Daimler **pneumatic-tired rail-car.** (1 900 words & fig.)

1933 **621 .43 (.44)**
Railway Age, No. 7, August 12, p. 238.
GLYNN (L. A.). — **French road extends rail-car service.** (1 900 words & fig.)

1933 **621 .39 (.73), 625 .18 (.73) & 625 .27 (.73)**
Railway Age, No. 7, August 12, p. 241.
Railway purchases show **expansion.** (1 700 words & fig.)

1933 **385 .3 (.73) & 656 .23 (.73)**
Railway Age, No. 7, August 12, p. 243.
The **Interstate Commerce Commission refuses to reduce rates.** (7 700 words.)

1933 **625 .143.2 (.73) & 625 .143.3 (.73)**
Railway Age, No. 7, August 12, p. 250.
GENNET (C. W. Jr.). — The **burden of defective rails.** (2 000 words.)

Railway Engineer. (London.)

1933 **621 .132.3 (.42)**
Railway Engineer, August, p. 225.
The **first L. M. S. Pacific.** (1 000 words.)

1933 **621 .392 & 625 .143.4**
Railway Engineer, August, p. 226.
Long rails. (1 000 words.)

1933 **656 .25 (.42**
Railway Engineer, August, p. 226.
Developments in railway signalling. (1 000 words.)

1933 **624 .1 (.489**
Railway Engineer, August, p. 228.
The **Storström bridge.** (1 300 words & fig.)

1933 **656 .256.3 (.492**
Railway Engineer, August, p. 229.
Automatic signalling on the Netherlands Railways (850 words.)

1933 **621 .132.3 (.42**
Railway Engineer, August, p. 231.
New **four-cylinder 4-6-2 express locomotive, L. M. S** Ry. (6 500 words & fig.)

1933 **621 .392 (.43) & 625 .143.4 (.43**
Railway Engineer, August, p. 239.
Rail welding in Germany. (1 800 words & fig.)

1933 **621 .98 (.42**
Railway Engineer, August, p. 241.
New **machine tools for railway shops. A heavy-dut crank-driven shaping machine.** (750 words & fig.)

1933 **625 .26 (.42**
Railway Engineer, August, p. 243.
Reorganisation of Stratford works, L. N. E. Ry (2 600 words & fig.)

1933 **621 .134.2 & 621 .134.**
Railway Engineer, August, p. 249.
Poppet or piston valves ? (500 words & fig.)

1933 **621 .3**
Railway Engineer, August, p. 250.
BYRNE (B. R.). — Possibilities of the **electri furnace in the foundry** — IV. (1 100 words.)

1933 **625 .14**
Railway Engineer, August, p. 252.
ALLEN (C. J.). — A **Steel Rail Congress.** (3 20 words.)

Railway Engineering and Maintenance. (Chicago.

1933 **725 .33 (.73**
Railway Engineering and Maintenance, August, p. 36
Is the **water station** obsolescent ? (5 600 words fig.)

1933 **625 .144.4 (.73) & 625 .173 (.73**
Railway Engineering and Maintenance, August, p. 36
Taking up track by panels. (800 words & fig.)

1933 **385 .587 (.73) & 625 .17 (.73**
Railway Engineering and Maintenance, August, p. 36
Erie Railroad **reorganizes its track forces.** (4 00 words & fig.)

1933 **625 .143 .4 (.73)**
Railway Engineering and Maintenance, August, p. 372.
Roll angle bars from scrap axles. (500 words.)

1933 **625 .13 (.73) & 691 (.73)**
Railway Engineering and Maintenance, August, p. 373.
Long precast bridge slabs erected rapidly. (2 000 words & fig.)

Railway Gazette. (London.)

1933 **656 .256.3 (.42)**
Railway Gazette, No. 5, August 4, p. 174.
Development in train description. (1 800 words & fig.)

1933 **621 .132.3 (.44)**
Railway Gazette, No. 5, August 4, p. 177.
French **single-expansion express locomotive.** (450 words & fig.)

1933 **621 .43 (.45)**
Railway Gazette, No. 5, August 4, p. 178.
Italian **petrol cars.** (400 words & fig.)

1933 **621 .331 (.42)**
Railway Gazette, No. 5, August 4, p. 179.
Mercury-arc rectifiers on the « Underground ». (2 300 words & fig.)

1933 **621 .132.6 (.51)**
Railway Gazette, No. 5, August 4, p. 182.
Powerful o-8-o **type tank locomotive** for China. (500 words & fig.)

1933 **625 .175 (.42)**
Railway Gazette, No. 6, August 11, p. 204.
A new **light inspection railcar.** (500 words & fig.)

1933 **625 .245 (.82) & 656 .213 (.82)**
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1933 **656 .25**
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New **engine shed** at Thornton, Fifeshire, L. N. E. Ry. (500 words & fig.)

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WINTERTON (P.). — **Railway travel in the Soviet Union.** (1 200 words & fig.)

1933 **385. (091 (.47)**
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WARD (O. E.). — **Controlling the cost of locomotive maintenance.** (3 000 words.)

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Railway shops badly in need of new tools. (1 000 words.)

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Centralized traffic control on the Pennsylvania. (1 600 words & fig.)

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OGUREK. — **New 2-8-2, series Pt 31 locomotives for express trains of the Polish State Railways.** (4 pages & fig.)

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1933 **625 214 = 91 .88**
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In Serbian.

(= 91.882)

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1933 **625 .216 = 91 .882**

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VANTUR. — **Draining railway fills and cuttings.** (4 1/2 pages & fig.)

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MILOSEVIC. — **The maintenance of locomotive, carriage and wagon axles.** (5 pages & fig.)

1933 **625 .143.2 = 91 .882**

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1933 **656 .237 = 91 .882**

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[016 .385. (02]

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In French.

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Annuaire 1933-34 de la Chambre Syndicale des Fabri-ants et Constructeurs de matériel pour chemins de fer t tramways.

Paris (8e), siège de la Chambre syndicale, 7, rue de Madrid. 1 volume, 528 pages. (Prix : 40 francs fran-ais.)

1933 621 .94

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Paris, Dunod, 1 volume, 112 pages et 125 figures. Prix : 27 francs français.)

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La statistique appliquée aux affaires.

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1933 669 .1

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Fabrication de l'acier au convertisseur basique scorie Thomas.

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La locomotive à surchauffe.

Bruxelles, Imprimerie F. van Buggenhoudt. 1 livre (16.5 × 24 cm.), 448 pages, 38 tableaux & 276 figures.

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Berlin, Wilhelm Ernst & Sohn, 2 Bände, jede 80 Sei-ten und Abbildungen. (Preis : je 5.50 R.M.)

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1933 33
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American policy in the Pacific. Proceedings of the Thirty-seventh Annual Meeting of the Academy, with additional papers on European international relations, presented before the Pacific Southwest Academy Center.

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The crisis of **democracy.** A broad survey of the operation of government in the United States.

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1933 625. (06 (.73)
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Revisions and additions to the manual :
Roadway : **Pipe line crossings under railway tracks.**
Rail : Relative merits of rail sections heavier than 130 lb.. — **Specifications for rails and spring washers.** — **Track tools.**
Buildings : **Specifications for buildings for railway purposes : Hydraulic elevators. Chimneys. Masonry.**
Grade crossings : « Numbers of tracks » signs.
Yard and terminals : **Rump yards with retarders. Formulæ used in designing gradients.**
*Ties :*Reneval statistics. 1932 and 1928 to 1933.

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1933 621 .132.1 (.4)
Engineer, No. 4050, August 25, p. 176; No. 4051, September 1, p. 200.
REED (B.). — Modern **European locomotive practice** (9 800 words & fig.)

1933 621 .9 (.42)
Engineer, No. 4050, August 25, p. 190.
Railway sleeper adzing and boring machine. (900 words & fig.)

1933 621 .133.1
Engineer, No. 4050, August 25, p. 191.
GORDON (K.). — The **hydrogenation of bituminous coal.** (3 500 words & tables.)

1933 621 .43
Engineer, No. 4050, August 25, p. 193.
Oil engine for rail traction. (250 words & fig.)

1933 621 .31
Engineer, No. 4050, August 25, p. 194.
Grid controlled **mercury arc rectifiers.** (1 000 words & fig.)

1933 388 (.42) & 621 .33 (.42)
Engineer, No. 4051, September 1, p. 211.
London **Passenger Transport Board and electrification.** (2 000 words.)

1933 064 (.42)
Engineer, No. 4052, September 8, p. 224; No. 4053, September 15, p. 248.
The Shipping, Engineering and Machinery Exhibition at Olympia. (7 000 words & fig.) (To be continued.)

1933 621 .132.8 (.42)
Engineer, No. 4052, September 8, p. 239.
The **Kitson-Still locomotive.** (2 000 words & fig.)

1933 669 .1
Engineer, No. 4052, September 8, p. 241.
Nickel cast iron. (2 000 words & fig.)

1933 624 .63 (.489)
Engineer, No. 4053, September 15, p. 261.
The Traneberg **arch bridge,** Stockholm. (3 400 words & fig.)

1933 62. (01 & 669
Engineer, No. 4053, September 15, p. 267.
WATTS (O. P.). — The **electro-chemical theory of corrosion.** (3 300 words.)

1933 669 .1
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The **quenching of steel.** (900 words & fig.)

1933 62. (0
The Metallurgist, p. 58, Supplement to the Enginee August 25.
Damping capacity and fatigue strength. (1 600 word 2 tables & fig.)

1933 62. (0
The Metallurgist, p. 63, Supplement to the Enginee August 25.
A new method for the **measurement of the modulu of elasticity.** (800 words & fig.)

1933 62. (01 & 66
The Metallurgist, p. 64, Supplement to the Enginee August 25.
The **testing of welds.** (500 words.)

Engineering. (London.)

1933 621 .133.
Engineering, No. 3528, August 25, p. 202.
Pulverised coal and colloidal fuel. (1 600 words.)

1933 621 (06 & 621 .
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The Scandinavian sectional meeting of the Worl Power Conference. — Section II, **Power and heat com bination.** (7 200 words.)

1933 53
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Pyrometer-type automatic **temperature-control appa ratus.** (1 800 words & fig.)

1933 624 .8 (.73
Engineering, No. 3529, September 1, p. 231.
The **University bridge, Seattle, Wash., U. S. A.** (60 words & fig.)

1933 621 .1 (06 & 621 .133.
Engineering, No. 3529, September 1, p. 232.
The Scandinavian sectional meeting of the Worl Power Conference. — Sub-Section I c, dealing wit **solid and liquid fuel.** (5 700 words.)

1933 621 .142.2 & 69
Engineering, No. 3530, September 8, p. 240.
The preservation of **railway sleepers.** (1 000 words.

1933 621. (06 & 621 .8
Engineering, No. 3530, September 8, p. 268.
The Scandinavian Sectional Meeting of the Worl Power Conference. — Section 6 on « The transmissio and adaptation of **motive power for industrial machi nery.** (5 300 words.)

1933 614 .8 & 625 .1
Engineering, No. 3530, September 8, p. 275.
Safety precautions in tunnel driving. (1 100 words.

1933 625 .21
Engineering, No. 3531, September 15, p. 315.
Universal **spring mounting for railway carriages an road vehicles.** (600 words & fig.)

1933 621 .116
ngineering, No. 3531, September 15, p. 316.
The Copes double-control boiler feed regulator. (600 ords & fig.)

Engineering News-Record. (New York.)

1933 624 .1 (.73) & 624 .32 (.73)
ngineering News-Record, No. 7, August 17, p. 189.
Foundations get under way on New Orleans bridge. 000 words & fig.)

1933 625 .122 (.73)
ngineering News-Record, No. 9, August 31, p. 245.
PROCTOR (R. R.). — Construction of rolled-earth ams. — I. Fundamental principles of soil compaction. 700 words & fig.)

1933 624 .62 (.73) & 693 (.73)
ngineering News-Record, No. 9, August 31, p. 259.
McGULLOUGH (C. B.). — Gunite incasement retains tegrity on Oregon road bridges. (1 000 words & fig.)

1933 621 .133.7 (.73)
ngineering News-Record, No. 10, September 7, p. 275.
FORESTER (D. M.). — Worst water in the West ade fit to drink. (2 900 words & fig.)

1933 624 (.71)
ngineering News-Record, No. 10, September 7, p. 284.
Rail and road bridges on same foundations. (1 200 ords & fig.)

1933 351 .712 (.73)
ngineering News-Record, No. 10, September 7, p. 290.
Text of code for engineers in construction industry. 700 words.)

Indian Railway Gazette. (Calcutta.)

1933 347 .763.4 (.73)
dian Railway Gazette, August, p. 160.
Emergency railroad legislation in the United States. 500 words.)

1933 621 .133.7 (.42)
dian Railway Gazette, August, p. 163.
Lime and soda ash water softening. (1 000 words fig.)

1933 614 (.54)
dian Railway Gazette, August, p. 168.
BRANSBY WILLIAMS (G.). — The sanitation of dian railway settlements. (4 200 words.)

urnal of the Institution of Engineers, Australia. (Sydney.)

1933 62. (01 & 669 .1
urnal Institut. of Eng., Australia, July, p. 248.
CORBETT (A. H.). — The testing of welds. (4 600 ords & fig.)

The Locomotive. (London.)

1933 621 .135.2 (.54)
The Locomotive, September 15, p. 258.
Standard I. S. B. « Z. B. » narrow gauge locomotives for India. (900 words & fig.)

1933 621 .135.1 (.44)
The Locomotive, September 15, p. 259.
Cab window deflector, State Railways of France. (150 words & fig.)

1933 621 .131.2 (.42) & 621 .131.3 (.42)
The Locomotive, September 15, p. 267.
Test of locomotive No. 6200 L. M. S. R. Euston-Crewe. (450 words.)

1933 621 .131.2 (.44) & 625 .245 (.44)
The Locomotive, September 15, p. 268.
Recording apparatus for dynamometer cars. (1 100 words & fig.)

1933 621 .13 (.492)
The Locomotive, September 15, p. 272.
DERENS (L.). — The Holland Railway Company and its locomotives. (2 200 words.) (To be continued.)

1933 621 .133.7
The Locomotive, September 15, p. 280.
The « Neckar » system of locomotive boiler water conditioning. (700 words & fig.)

1933 621 .43 (.66)
The Locomotive, September 15, p. 282.
Articulated Diesel locomotive for the Ashanti Gold-fields Corporation, Ltd. (1 400 words & fig.)

London & North Eastern Railway Magazine. Railway Engineer. (London.)

1933 621 .138.3 (.42)
London & North Eastern Ry. Mag., September, p. 490.
GAMBLE (S. A.). — Spray cleaning of locomotives. (500 words & fig.)

Mechanical Engineering. (New York.)

1933 38
Mechanical Engineering, September, p. 531.
GREENHALGH ALBION (R.). — The communication revolution 1760-1933. (6 700 words & fig.)

1933 385. (061.4 (.73) & 62. (01 (.73)
Mechanical Engineering, September, p. 539.
Research in railway engineering. (4 700 words & fig.)

1933 669 .1
Mechanical Engineering, September, p. 557.
EATON (G. M.). — Practical plasticity problems. (3 100 words & fig.)

1933 621 .89
Mechanical Engineering, September, p. 561.
HERSEY (M. D.). — Logic of oiliness. (6 700 words & fig.)

1933 669 .1
Mechanical Engineering, September, p. 581.
Creep and structural stability of nickel-chromium iron alloys at 1 600 F. (300 words.)

Modern Transport. (London.)

1933 656 .261 (.43)
Modern Transport, No. 754, August 26, p. 3.
Transporting rail wagons by road. (1 000 words.)

1933 621 .33 (.54)
Modern Transport, No. 754, August 26, p. 5.
Electrification of main line railways. Experience in India and elsewhere. (2 000 words.)

1933 621 .132.7 (.43) & 621 .43 (.43)
Modern Transport, No. 754, August 26, p. 6.
Railway methods in Germany. — No. 3. — Rail shunting tractors. (1 700 words.)

1933 385 .586 (.42)
Modern Transport, No. 754, August 26, p. 7.
RICHENS (F. G.). — Training of railway apprentices. Methods in the Locomotive Department. (1 900 words.)

1933 347 .763 (.43) & 656 .1 (.43)
Modern Transport, No. 755, September 2, p. 5.
Railway methods in Germany. — No. 4. — Rail v. Road. (2 300 words.)

1933 625 .232 (.42)
Modern Transport, No. 755, September 2, p. 6.
New third class sleeping cars for L. M. S. R. (800 words & fig.)

1933 625 .232 (.493)
Modern Transport, No. 755, September 2, p. 7.
All-metal rolling stock for Belgium. New anti-telescoping device. (1 400 words & fig.)

1933 385
Modern Transport, No. 755, September 2, p. 9.
Railways and canals. — Details of co-ordination agreement. (1 100 words.)

1933 621 .132.8 (.42)
Modern Transport, No. 756, September 9, p. 3.
Kitson-still locomotive in experimental service. Dynamometer car trials on the London and North Eastern Ry. (2 000 words & fig.)

1933 656 .225 (.42) & 656 .261 (.42)
Modern Transport, No. 756, September 9, p. 5.
Containers for fruit traffic. (600 words & fig.)

1933 725 .23 & 725 .3
Modern Transport, No. 756, September 9, p. 6.
Railway architecture. Euston and other London sta-tions. (2 400 words & fig.)

1933 621 .132.8 (.43
Modern Transport, No. 756, September 9, p. 9.
Germany reverts to steam. New policy adopted the design and construction of railcars. (1 000 wor & fig.)

1933 625 .1 (.48
Modern Transport, No. 757, September 16, p. 3.
STRAUSS (F.). — Development of the Norwegia State Railways. New construction despite depressio (2 300 words & fig.)

1933 656 .1 (.4
Modern Transport, No. 757, September 16, p. 6.
Long-distance coach services. Important decisio (1 200 words.)

1933 656 (.4
Modern Transport, No. 757, September 16, p. 7.
Air and rail services in Germany. Competition a co-operation. (2 200 words.)

1933 725 .31 (.7
Modern Transport, No. 757, September 16, p. 8.
One station replaces seven. New Union Terminal Cincinnati, U. S. A. (2 000 words & fig.)

Railway Age. (New York.)

1933 656 .211 (.7
Railway Age, No. 8, August 19, p. 271.
Complete grade separation project at Birmingha Ala. (4 400 words & fig.)

1933 621 .43 & 656 .22
Railway Age, No. 8, August 19, p. 276.
Is speed what the public wants ? Traffic develo ments series. Article No. 6. (2 800 words & fig.)

1933 385 .32 (.7
Railway Age, No. 8, August 19, p. 278.
Transportation service surveyed by co-ordinat (3 500 words.)

1933 621 .13
Railway Age, No. 8, August 19, p. 280.
TITUS (H. J.). — Locomotive design. — How affects maintenance expenses. (5 000 words & fig.)

1933 621 .139 (.73), 625 .18 (.73) & 625 .27 (.7
Railway Age, No. 8, August 19, p. 285.
Railroads review question of old materials. (2 words & fig.)

1933 621 .133.7 (.7
Railway Age, No. 9, August 26, p. 300.
GRIME (E. M.). — Zeolite water treatment me with favor on Northern Pacific .(3 400 words & fi

1933 625 .214
ilway Age, No. 9, August 26, p. 303.
Preparing journal bearings for service. (1 600 words fig.)

1933 625 .151 (.73) & 656 .256 .2 (.73)
ailway Age, No. 9, August 26, p. 310.
Manual-block installation includes spring switch on hesapeake & Ohio. (2 300 words & fig.)

1933 656 .1 (.42) & 656 .261 (.42)
ailway Age, No. 9, August 26, p. 315.
SHERRINGTON (C. E. R.). — How provide collec-on and delivery service? (2 700 words & fig.)

Railway Engineer. (London.)

1933 625 .143.3
ailway Engineer, September, p. 258.
Defective rails. (1 750 words & fig.)

1933 656 .253 (.42)
ailway Engineer, September, p. 261.
The re-signalling of St. Enoch Station, Glasgow. 5 000 words & fig.)

1933 621 .33
ailway Engineer, September, p. 270.
DARLING (C. S.). — Improved boiler performance, fficiency and flexibility. (2 200 words & fig.)

1933 656 .259 (.43)
ailway Engineer, September, p. 272.
The Kofler automatic train-stop on the Cologne-Bonn lectric railway. (500 words & fig.)

1933 627 (.42) & 656 .213 (.42)
ailway Engineer, September, p. 274.
Extension of Southampton docks, Southern Ry. (5 000 words & fig.)

1933 621 .33 (.41)
Railway Engineer, September, p. 280.
The Drumm battery. (1 000 words & fig.)

1933 621 .132.3 (.41)
Railway Engineer, September, p. 281.
Compound locomotive performance on the Great Northern Railway (Ireland). (1 600 words & fig.)

1933 624 (.42)
Railway Engineer, September, p. 285.
Pre-cast reinforced concrete footbridge. (350 words & fig.)

Railway Gazette. (London.)

1933 013 .385.113 (.42)
Railway Gazette, No. 8, August 25, p. 282.
Railway operating efficiency. (1 900 words & tables.)

1933 388 (.42)
Railway Gazette, No. 8, August 25, p. 285.
Cross-city railways in Berlin. (2 900 words & fig.)

1933 625 .212 (.42)
Railway Gazette, No. 8, August 25, p. 287.
« K. L. stronger steel ». (350 words & fig.)

1933 625 .245 (.44) & 656 .1 (.44)
Railway Gazette, No. 8, August 25, p. 292.
A French road-rail vehicle. (600 words.)

1933 621 .132.5 (.54)
Railway Gazette, No. 8, August 25, p. 293.
New British-built locomotives for India. (800 words & fig.)

1933 625 .235
Railway Gazette, No. 9, September 1, p. 315.
A reversible seat. (400 words & fig.)

1933 656 .253 (.485)
Railway Gazette, No. 9, September 1, p. 316.
Power signalling at Gothenburg, Sweden. (1 300 words & fig.)

1933 651 (.42)
Railway Gazette, No. 9, September 1, p. 318.
Ticket issuing, invoicing and accounting. (600 words & fig.)

1933 621 .131.3 (.44)
Railway Gazette, No. 9, September 1, p. 319.
Comparative trials of French express locomotives. (1 200 words & fig.)

1933 621 .392 & 625 .2
Railway Gazette, No. 9, September 1, p. 321.
Rolling-stock welding practice. (2 600 words & fig.)

1933 625 .232 (.42)
Railway Gazette, No. 9, September 1, p. 326.
New third-class sleeping cars, L. M. S. R. (750 words & fig.)

1933 656 .222.1 (.44)
Railway Gazette, No. 9, September 1, p. 328.
The acceleration of local services in France. (1 800 words & fig.)

1933 656 .211 (.42), 656 .212 (.42) & 725 .51 (.42)
Railway Gazette, No. 10, September 8, p. 345.
Modernising Paddington station, G. W. R. (1 900 words & fig.)

1933 621 .335 (.44) & 621 .43 (.44)
Diesel Railway Traction, p. 368, Supplement to the Railway Gazette, September 8.
New Diesel locomotives for the P. L. M. (1 100 words & fig.)

1933 **621 .335 & 621 .43**
Diesel Railway Traction, p. 371, Supplement to the Railway Gazette, September 8.
ZACHARIAE (H. A. K.). — **The railways and Diesel traction.** (1 800 words & fig.)

1933 **621 .335 (.73) & 621 .43 (.73)**
Diesel Railway Traction, p. 373, Supplement to the Railway Gazette, September 8,
A powerful Diesel-electric railcar. (750 words & fig.)

1933 **621 .43 (.66)**
Diesel Railway Traction, p. 374, Supplement to the Railway Gazette, September 8,
British-built Diesel-mechanical shunter. (1 300 words & fig.)

1933 **621. (06 & 621 .43**
Diesel Railway Traction, p. 375, Supplement to the Railway Gazette, September 8,
Diesel traction and the World Power Conference. (600 words.)

1933 **621 .43 (.5 + .6)**
Diesel Railway Traction, p. 376, Supplement to the Railway Gazette, September 8,
REED (B.). — **Development of Diesel traction. IV. — Asia and Africa.** (2 200 words & fig.)

1933 **621 .132.8 (.42)**
Diesel Railway Traction, p. 379, Supplement to the Railway Gazette, September 8,
The Kitson-Still locomotive. (2 200 words & fig.)

1933 **621 .131.3 (.54)**
Railway Gazette, No. 11, September 15, p. 379.
Testing standard locomotives in India. (450 words & fig.)

1933 **625 .144.4 & 625 .17**
Railway Gazette, No. 11, September 15, p. 383.
Labour saving on the permanent way. (500 words & fig.)

1933 **656 .283 (.42)**
Railway Gazette, No. 11, September 15, p. 389.
Ministry of Transport accident report. — Collision at Cockett, Great Western, April 18, 1933. (1 900 words & fig.)

1933 **625 .143.1 (.44)**
Railway Gazette, No. 11, September 15, p. 391.
New P. L. M. 125-lb. rails. (200 words.)

Proceedings, American Society of Civil Engineers (New York.)

1933 **624**
Proc., Amer. Soc. Civil Eng., August, p. 999.
FLETCHER (R.) and SNOW (J. P.). — **A history of the development of wooden bridges. — Discussion.** (7 000 words & fig.)

1933 **721 .**
Proc., Amer. Soc. Civil Eng., August, p. 1054.
WILCOXEN (L. C.), PARSONS (H. de B.), KIMBALL (W. P.) and MIDDLEBROOKS (T. A.). — **Earths and foundations. Progress report of specia committee.** (4 300 words & fig.)

Proceedings, Institution of Mechanical Engineers (London.)

1933 **621 .43 (.42)**
Proc., Institut. of Mech. Engineers, Vol. 124, p. 1.
FELL (Lt. Col. L. F. R.) — **The compression-ignition engine and its applicability to British railway traction.** (23 000 words & fig.)

1933 **656 .212.6 (.71) & 725 .36 (.71)**
Proc. Institut. of Mech. Engineers, Vol. 124, p. 69.
BROUGHTON (H. H.). — **The handling and storing of grain, with special reference to Canadian methods.** (46 000 words & fig.)

1933 **62. (0**
Proc., Institut. of Mech. Engineers, Vol. 124, p 305.
PULLIN (V. E.). — **Radium in engineering practice.** (12 000 words & fig.)

Transit Journal. (New York.)

1933 **388 (.73)**
Transit Journal, September, p. 269.
Taking people to the fair. — Special provisions for handling capacity loads to and from the « Century of Progress ». (3 900 words & fig.)

1933 **347 .763 (.73)**
Transit Journal, September, p. 275.
Code of fair competition for the transit industry. (3 200 words.)

1933 **621 .338 (.73)**
Transit Journal, September, p. 276.
Radical departures in new « L » car. (4 400 words & fig.)

1933 **621 .336 (.73)**
Transit Journal, September, p. 280.
POWELL (N. M.). — **Trolley shoes increase wire and collector life.** (1 100 words & fig.)

In Spanish.

Anales de la Asociacion de Antiguos Alumnos del I. C. A. I. (Madrid.)

1933 **621 .335 (.460)**
Anales de la Asociacion de Antiguos Alumnos del I. C. A. I., Agosto p, 403.
NAVARRETE y DEL SOLAR (J. M.). — **La locomotora eléctrica de gran velocidad de la Compañia del Norte, serie 7.300.** (2 500 palabras & fig.)

Ferrocarriles y Tranvias. (Madrid.)

1933 **625 .142.3**
›rrocarriles y Tranvias, Agosto, p. 292.
DOURDIL (L.). — Las traviesas metálicas. (2 900 ılabras & fig.)

1933 **656 .253 (.485)**
›rrocarriles y Tranvias, Agosto, p. 295; Septiembre, p. 319.
HARD (T.). — La señalización de la estación central Gotemburgo. (11 000 palabras, 2 cuadros & fig.) (Continuará.)

1933 **656 (.82)**
›rrocarriles y Tranvias, Septiembre, p. 327.
JUSTO (A. P.) & ALVARADO (M. R.). — La coornación de los transportes en la Argentina. (2 900 ılabras.)

Los Transportes. (Madrid.)

1933 **385 .517.6 (.460)**
›s Transportes, nº 358, 15 Agosto, p. 230.
Los servicios sanitarios en los ferrocarriles de . Z. A. (1 800 palabras & fig.)

Revista de Ingenieria Industrial. (Madrid.)

1933 **621 .33 (.460)**
evista de Ingenieria industrial, Agosto, p. 253.
DE COS (F.). — La electrificación de Madrid-Avilaegovia y la oportunidad de emprender actualmente n programa general de electrificaciones. (3 000 palaras.)

1933 **625 .212**
evista de Ingenieria industrial, Agosto, p. 261.
SIMON (R.). — Consideraciones sobre el material e los ejes para ferrocarriles. (1 200 palabras & fig.)

Revista de Obras Publicas. (Madrid.)

1933 **385 (.460)**
evista de Obras Publicas, nº 17, 1º de Septiembre, p. 369.
BARCELO (J.). — La nacionalización de los ferroarriles. (2 500 palabras.)

1933 **624 .6 & 721 .4**
evista de Obras Publicas, nº 18, 15 de Septiembre, p. 389.
CASADO (C. F.). — Teoria del arco. (3 300 palabras, cuadros & fig.)

In Italian.

L'Ingegnere. (Roma.)

1933 **624 .6**
L'Ingegnere, settembre, p. 667.
APRILE (G.) e INCORVAJA. — Sul calcolo rapido degli archi incastrati. (1 700 parole, 2 tavole & fig.)

Rivista tecnica delle ferrovie italiane. (Roma.)

1933 **621 .43 (.43)**
Rivista tecnica delle ferrovie italiane, nº 2, 15 agosto, p. 4.
NAPOLI (A. di). — L'automotrice rapida delle ferrovie Tedesche. (3 300 parole & fig.)

1933 **621 .135.3**
Rivista tecnica delle ferrovie italiane, nº 2, 15 agosto, p. 69.
DIEGOLI (M.). — I cuscinetti delle bielle nelle locomotive veloci. (7 000 parole & fig.)

1933 **625 .143.3**
Rivista tecnica delle ferrovie italiane, nº 2, 15 agosto, p. 95.
FORCELLA (P.). — Il tipo di rottura in opera delle rotaie in relazione alle prove di resistenza ed a quelle ad urti ritenuti a flessione alterna. (4 000 parole & fig.)

In Dutch.

De Ingenieur. (Den Haag.)

1933 **624 .52 (.492)**
De Ingenieur, Nr 34, 25 Augustus, p. B. 197.
HARMSEN (W. J. H.). — Brug voor gewoon verkeer over den Nederrijn te Arnhem. (6 800 woorden & fig.)

1933 **624 .62 (.485)**
De Ingenieur, Nr 35, 1 September, p. Bt. 17.
NILLSON (E.). — De Tranebergsbrug te Stockholm. (1 600 woorden & fig.)

Spoor- en Tramwegen. (Utrecht.)

1933 **621 .33 (.492)**
Spoor- en Tramwegen, Nr 18, 29 Augustus, p. 465; Nr 19, 12 September, p. 496.
SLOTHOUWER (J. F. A.). — Electrificatie Rotterdam-Dordrecht. Vernieuwing van de viaduct te Rotterdam. (1 900 woorden & fig.)

1933 **621 .131.3 (.492)**
Spoor- en Tramwegen, Nr 18, 29 Augustus, p. 467.
PONT (W. A. C.). — De meetwagen der Nederlansche Spoorwegen. (1 600 woorden & fig.)

1933 **621 .43**
Spoor- en Tramwegen, Nr 19, 12 September, p. 489.
HAGEDOORN (C. F. J.). Zes jaar Diesel-motor-practijk. (2 500 woorden.)

In Portuguese.

Gazeta dos caminhos de ferro. (Lisboa.)

1933 **385 (.469)**
Gazeta dos caminhos de ferro, nº 1098, 16 de setembro, p. 515.
FERNANDO DE SOUSA (J.). — **Plano de agrupamento das linhas ferreas.** (2 700 palavras.)

In Serbian.

(= 91.882)

Saobračajni pregled. (Beograd.)

1933 **385. (071 (.497.1) = 91 .882**
Saobracajni pregled, No. 3, p. 131.
REPIC. — **The « Academy » (upper school) of the Jugoslav Railways.** (3 pages.)

1933 **385 .15 = 91 .882**
Saobracajni pregled, No. 4, p. 141; No. 6, p. 243.
PETROVIC. — **Autonomy in railway working.** (28 1/2 pages & fig.)

1933 **656 .1 = 91 .882 & 656 .2 = 91 .882**
Saobracajni pregled, No. 4, p. 155.
MAISAC. — **Rail and road.** (2 pages.)

1933 **385 .52 = 91 .88**
Saobracajni pregled, No. 4, p. 163.
STEFANOVIC. — **Various wages systems with view to increasing the workmen's output.** (5 1/2 pages

1933 **385 .15 = 91 .88**
Saobracajni pregled, No. 5, p. 181.
REPIC. — **The autonomy of the State Railway** (5 pages.)

1933 **656 .213 = 91 .88**
Saobracajni pregled, No. 5, p. 189.
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VOL. XV — N° 12

DECEMBER 1933

Monthly Bulletin of the International Railway Congress Association

(English Edition)

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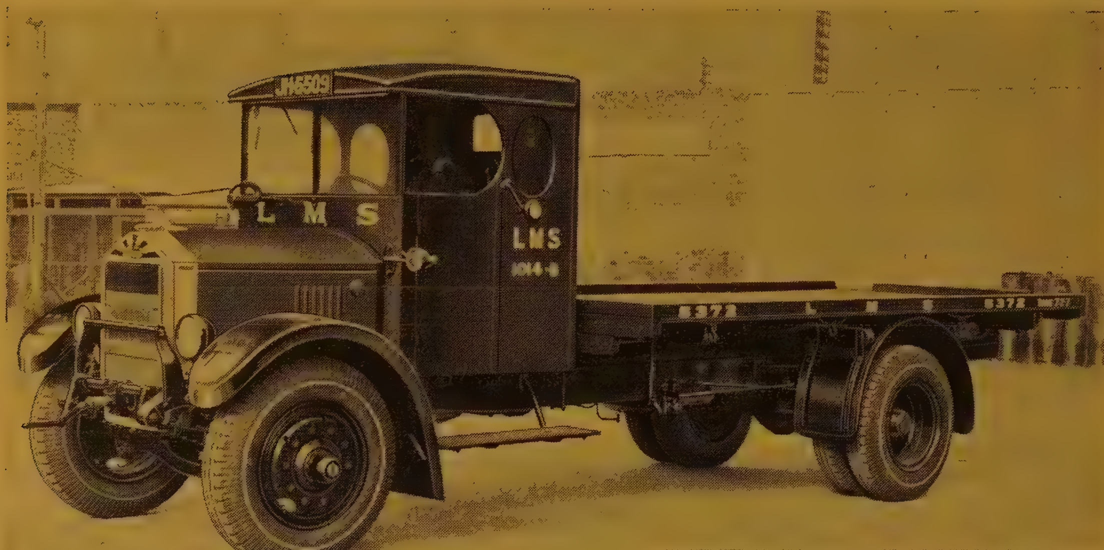

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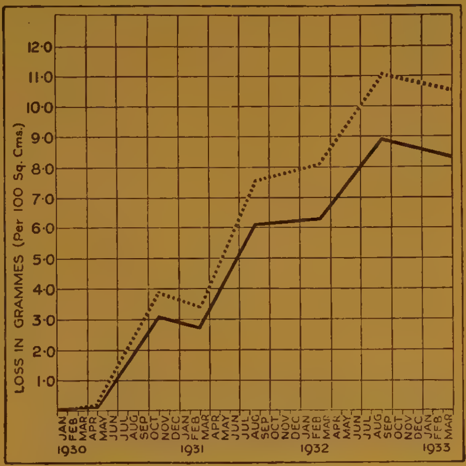

Tests on plates exposed on an industrial canteen roof. The size of each specimen was :—
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KEY TO GRAPH
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KUPLUS ————

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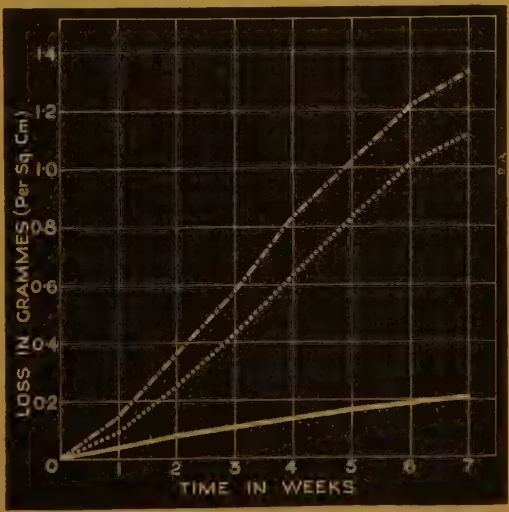

Tests for corrosion in 1% sulphuric acid.

KEY TO GRAPH
Mild Steel (a) -·-·-·-
Mild Steel (b) ....
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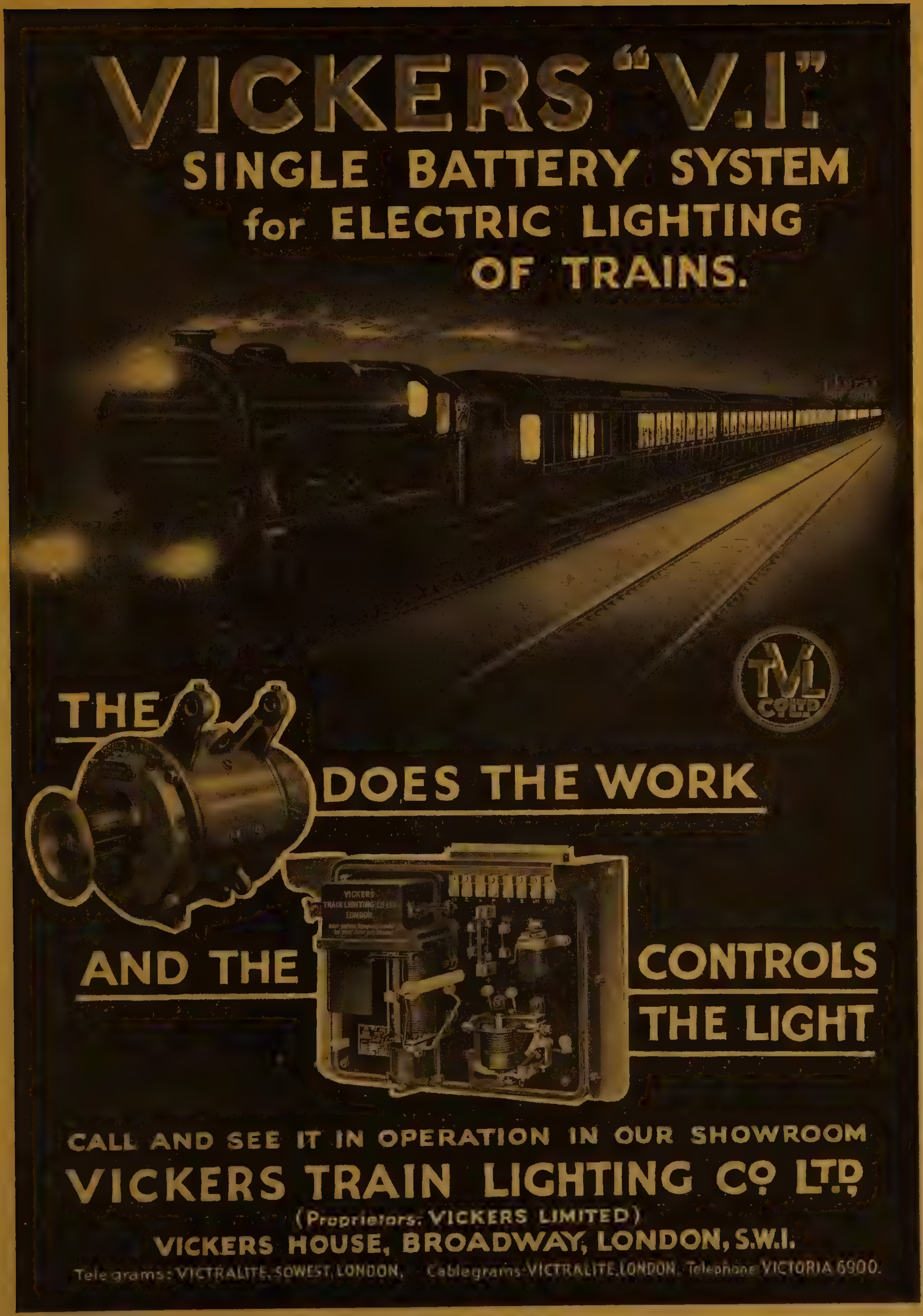
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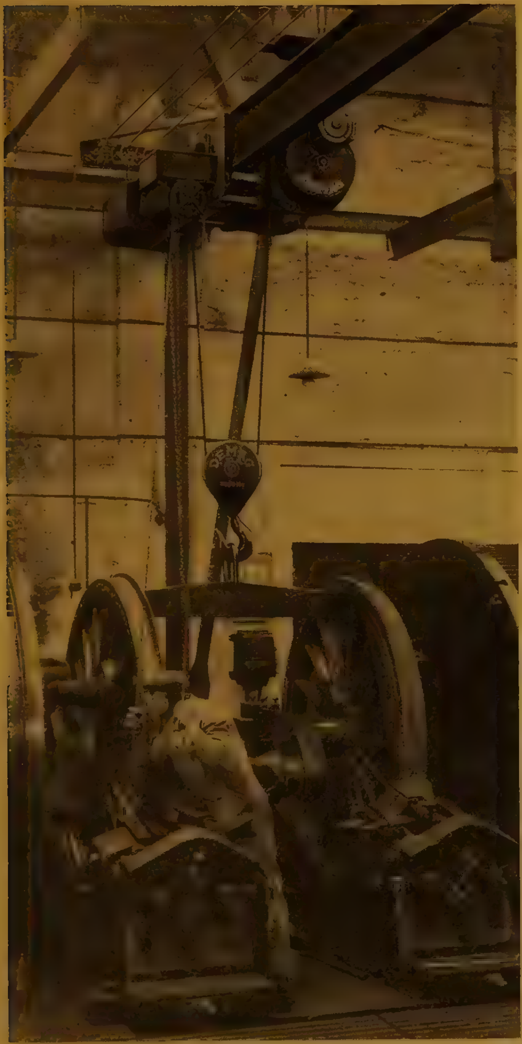

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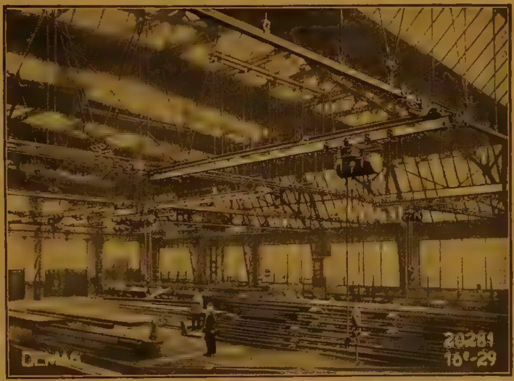

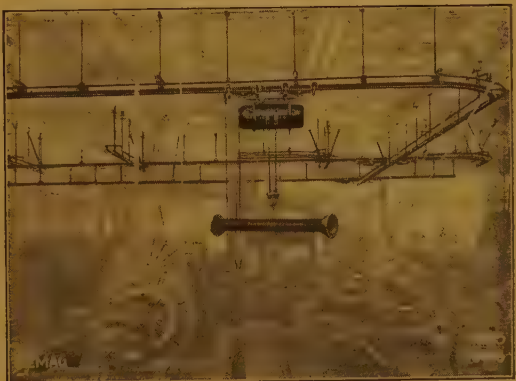

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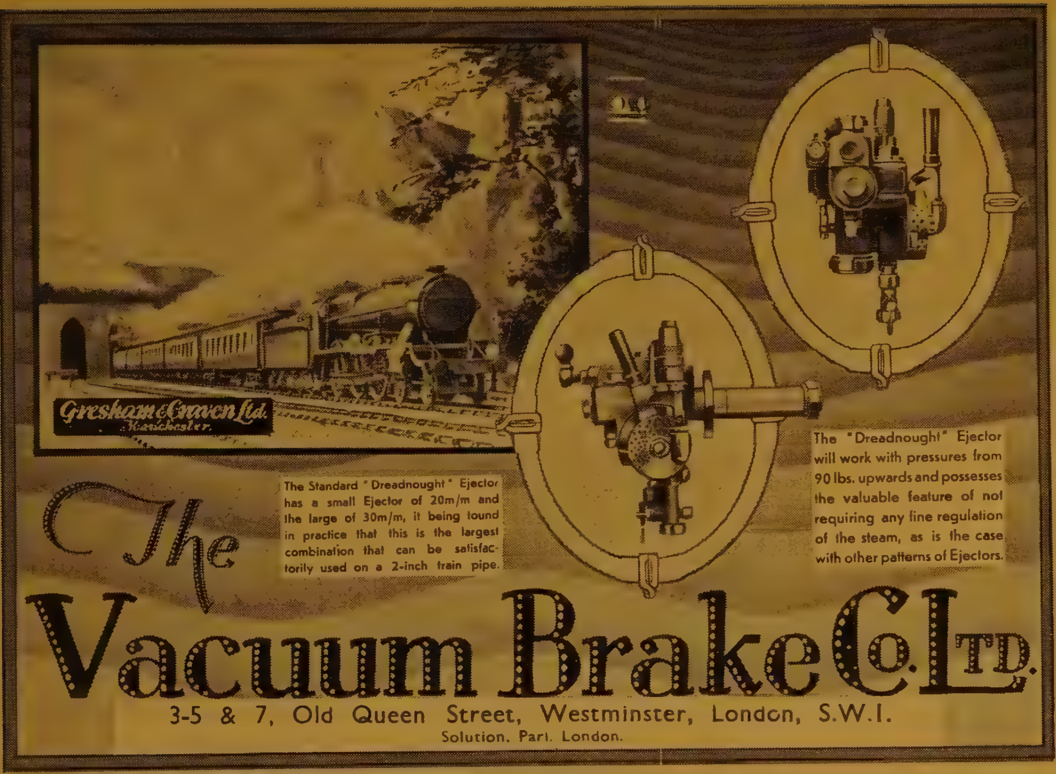
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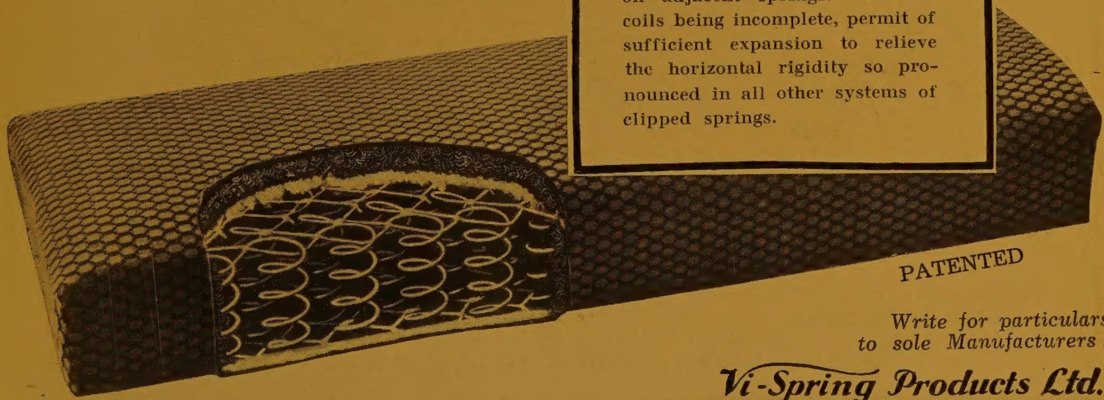

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